THE MODEL ENGINEER

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THE

MODEL ENGINEER

Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

SMOKE RINGS

Our New Year Competition

MY little competition for the exchange of New Year greetings between MODEL ENGINEER readers certainly aroused a flow of good will which it delighted my heart to receive. The poets were quickly to the front and some very neat verses from various correspondents ranked high in the judging. In fact, a five-verse poem entitled, "Carry On," from Mr. W. H. Bodfish, of Burnham, Bucks, topped the list of the efforts in serious vein, and earned the £2 2s. prize. The humorists were, I think, not so successful generally, but Mr. W. D. Hollings, of Bradford, caught the spirit of the competition in an amusing piece of advice to "wood and metal spoilers" and will accordingly receive a similar prize. The winning efforts, and some extracts from the other post-cards will appear in an early issue to convey their expressions of good will to one and all.

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The "M.C.N. Special" Model Racing Car

READERS who are interested in the development of model racing cars will welcome the news that a complete and fully detailed design for one of these cars is now being described in our companion journal, *Model Car News.* The design has been prepared to satisfy the demands expressed by many readers of this journal, and is the joint work of Mr. Edgar T. Westbury and Mr. C. B. Maycock. It comprises all necessary information for the construction of a car which complies with British racing rules, suitable for engines up to 10 c.c., and the construction of all essential components, including the wheels, engine, centrifugal clutch, transmission gear, etc., will be described in detail. While the design is intended primarily to assist the beginner, who tackles this class of work for the first time, and is therefore kept as simple and straightforward as possible, it is nevertheless highly efficient, and may, moreover, be used as the basis for the evolution of a more advanced and elaborate design. *Model Car News* is published monthly, price 6d., and although circulation is strictly limited by present paper rationing regulations, it may be mentioned that there are still a few vacancies left for intending new subscribers.

Thieves at Victoria Park

NEWS reaches me of a burglary at the boat-house of the Victoria Model Steamboat Club, in Victoria Park, the scene of many famous power-boat regattas. It appears that several pairs of waders were stolen, and one boat, the cabin cruiser *Lilric.* A model of the paddle-steamer *Royal Sovereign* was damaged. The *Lilric* is 4 ft. 6 in. overall, with a beam of 11 in.; she has a round stern and two bilge keels, and is driven by a 40 c.c.

water-cooled petrol motor. Any news of the whereabouts of this boat would be welcomed by Mr. A. A. Sherwood, 47, Eltham Palace Road, London, S.E.9. I would express my sympathy with the Victoria Club in this unpleasant experience which is not the first occasion on which a similar theft has occurred.

Our Cover Picture

THIS week our artist shows the ever popular steam traction engine doing its bit on a wartime job. It is not often that a photograph of an engine of this type is the subject of an artistic pen, but we hope our readers will agree that the treatment is particularly successful. In spite of the development of the petrol motor tractor in recent years the steam engine is by no means a back number. A well-known Midland engineering firm has just reported a large order for steam road-rollers for road construction in India. Model engineers have a soft spot in their hearts for the steam engine and will continue to model these giants of the road for many years to come.

The photograph from which our artist sketched the front cover of this issue

Making Model Furniture

A VERY well-known model railway enthusiast tells me that for good and sufficient reasons, he has been obliged to give up this particular hobby and hand over his elaborate layout to a friend, who will carry on the traditions of its miniature service. But he has not abandoned his interest in model making, for he now finds agreeable occupation in the construction of model furniture, a less tiring but very absorbing pursuit. He says :—"The manufacture of Chippendale chairs, and bureaus with drawers that open and shut properly, in a scale of 1 in. to the foot, is quite a job. Last summer I made a grand piano—it did everything but play a tune, for I couldn't manage that!" I like his declaration of scale, for that shows the true model engineering instinct. In the last MODEL ENGINEER Exhibition we had a delightful piece of model craft by Mr. Frost, the one-armed pattern-making expert. This was a Windsor chair, only a few inches high, but a perfect replica of the real article. I pointed it out to many visitors who were charmed by its delicate construction and finish. Furniture making may seem to be far removed from engine building, but yet it embodies that love of miniature craftsmanship which is the guiding star of all model engineers, particularly when it is true to scale. It is closely akin to model ship building, in that the tools and materials are much the same, and anyone who has followed the history of the cabinet maker's art as linked with the names of Chippendale, Sheraton, and other past masters of that period, will know how closely the virtues of the artist and the craftsman have been combined. So a railway enthusiast who turns to model furniture making is not really a renegade from our field, he is merely switching on to a branch line in which his inborn love of miniature work will continue to provide him with happy occupation. He may even switch back on the the main line and apply his woodworking skill to the construction of model rolling stock, and the furnishing of Pullman cars and other centres of passenger comfort.

A Model Theatre Library

I HAVE lately received a list of the books on puppetry and the model theatre in the library of The British Puppet and Model Theatre Guild. I am surprised at the extent of the literature on this subject. Over one hundred books are listed on model theatres, puppets, marionettes and plays for performance, and on the other aspects of theatrical work which are related to this attractive form of entertainment in miniature. The books are available on loan to members of the Guild, the Hon. Librarian being Mr. Hubert A. Purser, 66, Honor Oak Road, Forest Hill, S.E.23. The Council has decided to encourage the formation of local groups to cater for country members. One of the activities suggested for such groups is the construction to scale of a model of the local theatre, or a local theatre which has disappeared but of which records remain. Readers who would like further information should write to the hon. secretary, Miss Ann Bussell, "Wood View," Hadley Highstone, Barnet, Herts.

"Old Bill" at Belfast

I HEAR that Mr. James Crebbin's well-known locomotive, "Old Bill," is shortly to cross the Irish Channel to make an appearance at the exhibition planned by the Ulster Society for April next. This is by the Society's special request, with which "Uncle Jim" has very willingly promised to comply. An excellent ambassador this.

Percival Marshall

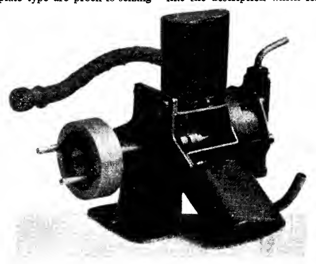
A SIMPLE THREE-CYLINDER STEAM ENGINE

Incorporating a novel valve gear

By P. H. MORRISON

THE writer had a desire to build a simple engine, primarily for model marine purposes, that would " self start " when the regulator is opened. For simple construction, the " radial " type of engine has many advantages, such as: overhung single-throw crankshaft, one-piece connecting-rods, simple layout generally. An engine of this type may be well balanced, if the counterweight on the crank web is made the equivalent weight of the total assembly of pistons, connecting-rods and big-end bush considered as acting at the crankpin centre. The engine to be described does not satisfy the above requirement fully, but there is little evidence of vibration at 3,000 r.p.m.

In planning the engine, much thought was given to the question of a suitable valve arrangement; the line taken was that the simplest steam distribution for a radial engine would be obtained by using a rotary valve driven direct by the crankshaft, but rotary valves of the ordinary cylindrical or faceplate type are proen to seizing and scoring, especially if the lubrication is not seriously dealt with. Therefore the writer could not help wishing to use the good old reliable slide-valve which can be made easily and will usually remain tight for ages. However, the complication of three separate valves was to be avoided if possible, and eventually it was realised that the normal reciprocating movement of the slide valve could be approximately maintained in driving it by an eccentric engaging within a circular exhaust cavity, then by making the steam edge circular also, the valve, although moving in a circular orbit on the steam face, would have a reciprocating characteristic with respect to each of the three steam ports (one for each cylinder), equally spaced around the valve track. Examination of Fig. 1 will show how the above scheme has been carried out, and it should be noted that the valve is able to " seat " by virtue of the steam pressure on it, and is able freely to take up its own level on the steam face. Although the valve moves in a circular path, it is not forced to rotate about its own centre; this allows almost perfect lapping of the valve and the steam face when the engine is running, which keeps the faces steam-tight as long as the engine lives! It will be seen that the eccentric and its spindle are on the exhaust side of the valve, and consequently no stuffing-box is required, which, it should be agreed, is another advantage; and it would be hard to find a simpler valve-operating mechanism than the short spindle with the eccentric at one and, and the other driven direct by a slotted disc which engages an extension of the crankpin. Large-diameter port passages make connection between the cylinder heads and the steam-chest base. Perusal of the drawings will make these and other points clear. The engine built by the writer utilised a lot of " scrap," and is not exactly like the description which follows, although, as will be seen by the photograph, the differences are negligible.



The engine as built by the writer

Construction

The construction to be described is only suitable for an engine to operate on not more than a mild touch of superheat in the steam, but the details and materials could be modified to make a " hot dry job " if required, and the writer would be pleased to describe an alternative design suitable for flash steam if readers so wish; this, of course, with the Editor's approval.

Crankcase

This is built up from $\frac{1}{16}$-in. sheet brass, and consists of two parts, a back-plate (Fig. 2) carrying the main bearing, which is secured to the crankcase frame (Fig. 3) by six 6-B.A. screws. The crankcase frame carries the cylinders and steam-chest base. Mark out the back-plate as shown in

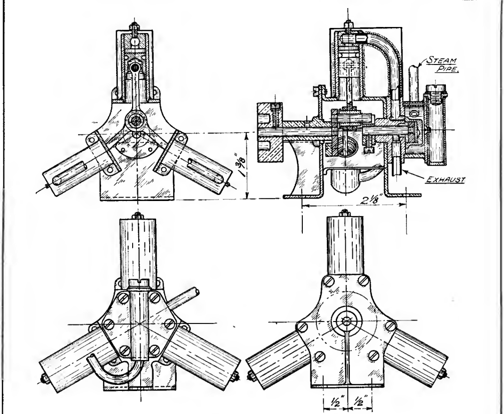


Fig. 1. General arrangement of three-cylinder steam engine

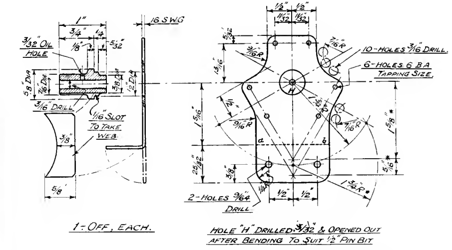


Fig. 2. Crankcase backplate

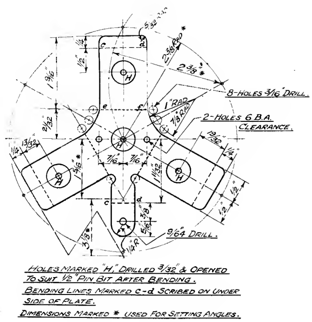


Fig. 3. *Crankcase frame*

Fig. 2, the curved portions of the outline being drilled away as indicated, leaving a slight allowance for filing up to shape. Use a pin bit to drill centre ½ in. diameter hole. To bend the foot, clamp work between two pieces of bright mild steel about 2 in. by ½ in. section, set the scribed line *a-b* to one edge of the bending bar, and clamp up with the backing bar a shade below the line, carefully "tap" the projecting foot over on to the bending bar. A word of warning: make sure that the metal is annealed before attempting the bend.

In marking out the crankcase parts, scribe the three centre lines first, at 120 degrees apart, which easily done by making a large circle and "stepping off" the radius thus, marking six equidistant points, as shown by the dimensions marked*; the dimensions are arranged so that the marking out may be performed with the aid of only the homely square, rule, dividers and scriber. After marking out and cutting to shape the crankcase frame, drill holes as directed in Fig. 3. The bending of this frame calls for greater care; first bend the short-end flanges at right-angles, setting the bending bar up to the lines *c-d* scribed on the back of the plate, and bend over towards these lines. Set edge of bending bar up to the line *e-f*, in the manner indicated in Fig. 3a, and bend in turn at each similar line; it will be found that, if a ½-in. thick bending bar is used, there will be sufficient clearance in the resultant "gaps" to prevent "fouling" of the already bent portions. If the above methods are used, no special formers are required, and if the work is performed with reasonable care, the result, as shown in Fig. 3b, should be quite satisfactory and interesting. The three gaps will be found useful when opening out the 3/32-in. diameter holes, as they enable the pin bit to drill from the inside, whilst the outside surfaces are each supported in turn on a drilling block. The two parts of the crankcase may now be clamped together, with the centre lines matched, and the whole squared up; while in the clamps a touch of solder applied to each of the flange joints will hold the parts when the clamps are removed for drilling, through from the backplate, 6-B.A. tapping size holes. After this operation, separate the two parts and tap the holes in the crankcase frame, 6-B.A., and open those in the backplate to 6-B.A. clear. The next item should be the main bearing shown on Fig. 2; this is turned from brass rod, and if the $\frac{3}{16}$-in. drill (or the reamer) leaves the hole a tight fit to the piece of silver steel you have selected for the crankshaft, a soft improvised reamer can be made from a piece of the steel (see Fig. 4), the cutting edge [?] being punched up just enough to enlarge the hole to a close running fit on the silver steel; be careful not to overdo it by producing a sloppy fit.

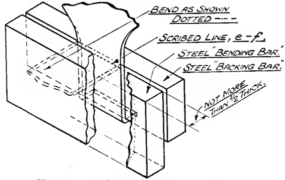


Fig. 3*a*. *"Set up" for bending plates*

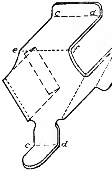


Fig. 3*b*. *Crankcase frame after bending*

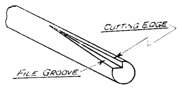


Fig. 4

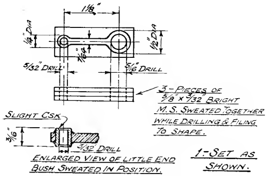


Fig. 6. Connecting-rods

Steam Block

The material is brass rod or cast blank, and all dimensions and hints are given in Fig. 5. Scribe the pitch circle for the steam ports while the job is in the chuck for turning the steam face, spigot, and drilling the central holes. The soft reamer can be used again to create a further running fit to the eccentric spindle. It will be safest to drill the three holes *A*, *D*, *E* $\frac{3}{16}$ in. diameter; after the actual steam ports have been drilled 3/32 in. diameter and 9/32 in. deep, as the $\frac{3}{16}$-in. holes can be drilled just deep enough to meet the full diameter of the small holes, without any danger

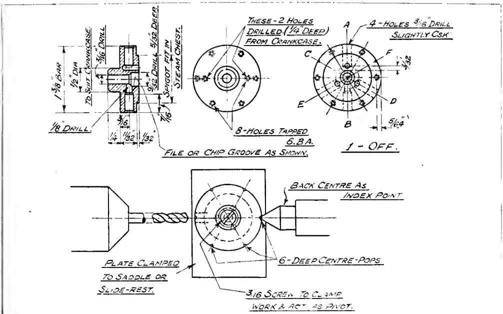


Fig. 5. Steam block

of breaking through into the exhaust port at the centre. The steam face may be finished flat by lapping with very fine grinding paste on a piece of plate glass. Place the steam block in position on the crankcase frame, with the top valve port *A* set to the vertical centre line of frame, and mark the position of the two 6-B.A. holes, which may then be drilled and tapped in the back of the block; there will then be something else to assemble for a brief scrutiny. The main bearing should now be soldered into the assembled crankcase, a piece of $\frac{3}{16}$-in. silver steel being passed through both the bearing and steam block, also at the same time solder the web piece (Fig. 2) in position in the $\frac{1}{16}$-in. slot.

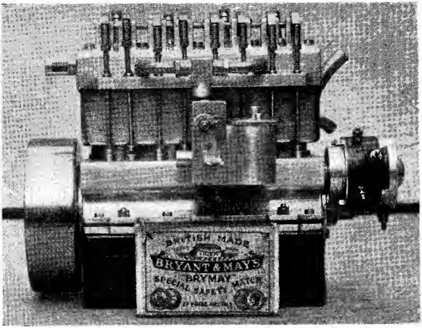
Cylinders

These are made from solid drawn brass tube, $\frac{7}{16}$ in. diameter inside, and outside diameter from $\frac{9}{16}$ in. to $\frac{5}{8}$ in. The reader should select tube with the inside nice and circular, smooth and straight, when it will be sufficient to lap the inside slightly without having to bore same. Turn the $\frac{1}{2}$-in. diameter spigot on the end, a tight fit to the holes in the crankcase frame.

Cylinder Caps

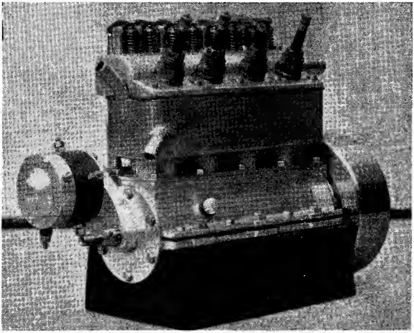
Made from brass rod; Fig. 9 will give the details necessary.

(To be continued)



A 4-Cylinder O.H.V. Engine

Mr. P. J. Goodchild, a member of the Clacton Model Engineering Club, has designed and built the 14-c.c. 4-cylinder engine illustrated herewith. All the castings and parts were home-made, the only purchased items being the ball-races. The engine is 6½ in. long, 5 in. high and 3½ in. wide; it was on show at "The Model Engineer" Exhibition last August



★The Story of a Petrol Engine by J.L.

holding in the vice and doing some hard hammering. But the second and third bends were a different proposition and, viewing the result after about a dozen heats, I had to admit that the battered and blistered piece of steel would never machine up into a crankshaft.

In the end, a fresh bar was forged up quite satisfactorily by the local blacksmith, and at the same time he also bent over the two outer ends of the shaft in the plane of the crank, so as to take the throw centres, to avoid making special throw plates.

The turning of the crank was accomplished without mishap and, after bushes had been fitted to the crankcase, the engine began to take shape.

A suitable flywheel was found in the local

IN due course, after the piston and rings had been made according to the directions, they in turn were worked up and down the bore with oil and emery until the rings showed a reasonable fit; but I don't recollect that there was very much compression.

Excellent directions were given in the published description for moulding and casting the two halves of the crankcase, and from my later experience of making aluminium castings at home, it would probably have been within my capacity to have proceeded according to the book. However, I shied at that bit; made a pattern of a square case for want of being able to turn a circular one, painted it red, and took it to my friend the ironmonger with instructions to get two castings in iron.

When the castings arrived, I was much astonished to find that the foundry had mistaken the bearing boss for a core print and, instead of a boss, a large round hole appeared instead.

As the pattern was all painted one colour, it was difficult to know why the mistake was made, but after I had explained what was wrong, they replaced them with a correct pair.

After the two halves of the crankcase had been faced up with a file and bolted together, they were sent away to have the main bearings bored and the recess turned for the bottom of the cylinder, as this was a job that was beyond all contriving on a $1\frac{1}{2}$-in. lathe.

In the meantime, I made an attempt to forge the crankshaft from a length of $\frac{5}{8}$-in. diameter bar.

Those were the days of the old-fashioned kitchen range and no coal shortage; and, once the reluctance of the domestic authorities to using the kitchen fire had been overcome, there was no great difficulty about getting plenty of heat on the bar and in getting the first bend all right by

garage; it had once served on a "Fairy" motor cycle, an early flat twin, which, I believe, was the forerunner of the Douglas; at any rate, it was of a similar type to that used on the Douglas.

It was, naturally, a bit big for my engine, but the main trouble was that the boss had a taper bore considerably larger than my $\frac{3}{8}$-in. diameter shaft. It obviously had to be bushed, but there were difficulties in holding the taper bush in the hole, as I could cut no screw threads in the lathe, and my largest die was $\frac{1}{4}$-in. Whitworth.

In the end, the taper bush was locked by tapping two $\frac{1}{4}$-in. Whitworth holes lengthwise, half in the bush and half in the flywheel boss, and screwing in plugs as tightly as possible. The bush was secured to the crankshaft in a somewhat similar way, by driving in two small taper pins lengthways along the join. Not very orthodox, perhaps, but it seemed a quicker and easier method than making a keyway.

When all was finished, the flywheel had a very noticeable sideways wobble, which was not to be wondered at.

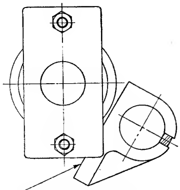
The original engine had a mild-steel connecting-rod with an unbushed split big-end. I had enough sense to know that this was not likely to run very long on the mild-steel crankpin, and so I made a pair of brasses of the conventional pattern, and fitted them.

The engine at this stage wanted only a carburettor and a water jacket to finish it, and I was very impatient to hear it pop, so it was bolted down at one end of a longish beam, which I had had my eye on for some time as being a suitable basis for my electric light plant.

I had a $\frac{1}{2}$-in. induction coil made some time previously from instructions given in THE MODEL ENGINEER Handbook, and when this was connected up to a newly-charged accumulator, the engine was ready for its first trial.

The naked inlet valve was doped with a few drops of petrol and after a few pulls it started up

*Continued from page 42, "M.E.," January 9, 1947.



The noise and smell were extremely satisfying, and the feeling of considerable power, which seemed to be evident by pressing on the rim of the flywheel, gave me confidence that at last I should have more than ample power to drive the dynamo to the very limit of its capacity.

A wooden pulley was soon sawn out, and after bolting it to the flywheel, it was turned true in position with a wood chisel supported on an improvised hand rest.

Then with the dynamo screwed down at the far end of my beam, and a nice long 1-in. wide rawhide belt on the pulleys, the outfit really began to look like something.

It looked so well that a photograph was taken of it on the back lawn. Much to my regret, this record of the engine's early days has now been lost.

My expectations with regard to the power of the engine were fully justified, as the engine drove the dynamo to such effect that all the small lamps connected to the terminals were lit to dazzling brilliance and then burnt out.

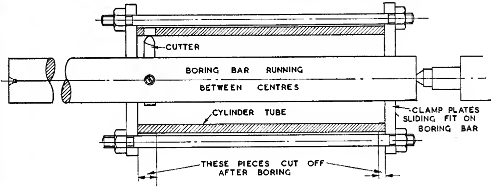


Fig. 3. *Method of boring cylinder*

in fine style and made about half-a-dozen consecutive bangs, gaining speed in a manner which promised well for the time when it should have a proper carburettor.

I was delighted with the noise and violence of it, and the sight of the red and blue flame at the exhaust valve filled me with enthusiasm.

The carburettor was copied faithfully from the instructions, and caused me little difficulty; it was all soldered together from pieces of brass tube.

The water jacket was a large tin with a hole cut in the bottom to fit the cylinder and soldered into position. The top was left open, and all was then in train for a proper run.

There was little difficulty in starting up, and in spite of chronic bouts of misfiring, I soon had the engine rattling round at a speed that threatened to shake it off its foundations.

I soon discovered that the misfiring was a permanent feature of its behaviour, and no alterations to the mixture or any other adjustments I could make seemed to effect any improvement.

However, I fancied that it tended to do better with the flywheel slightly braked than if left to run free, and so concluded that it would probably help to have it driving a load.

Efforts were now made to get the engine running properly, and to cure the misfiring. A throttle was fitted to the carburettor to control the speed, and everything was checked over as regards the ignition and mixture that I could think of, but without much improvement.

It was discovered a good deal later that the trouble lay with the plug, the mica insulation of which had partly broken down, but as this was about the only bought component on the engine, it hardly occurred to me to question it, especially as it always seemed to spark in healthy fashion when out of the cylinder.

In the meantime, almost everything else came under suspicion in turn. The wipe contact and trembler were discarded for a contact-breaker. Valve guides were made and fitted to the head, in case the valves were not seating squarely, but all without any result.

Then one day, when the engine was running light at a good speed, the crankshaft broke off close to the flywheel, which dropped off, still spinning, on to the floor, finally colliding with the wall with a noise like a tuning fork.

At first it was suspected that this disaster must

have been due to the flywheel being too heavy for the shaft, but when the engine was stripped the real reason was discovered. The big-end had come adrift, due to slackening or breaking of the screws, and the connecting-rod was found jammed inside the crankcase, which explained the sudden stop that sheared the shaft.

A new shaft and connecting-rod were made, and locknuts fitted to studs in the big-end, to make things more secure.

The flywheel was secured on to the new shaft with a normal key and keyway, as in gas engine practice, as the taper pins had come loose previously on several occasions.

Naturally, the new crank did nothing to cure the misfiring, and as I could find no reason for it, I imagined that perhaps it was due to the bad compression, which had certainly not improved, as I had hoped, after a little running.

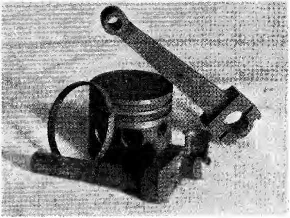


Fig. 4. Scrap from the junk box. The second piston, third connecting-rod, and third crankshaft

I saw an advertisement in one of the motor papers by a firm who offered to rebore your cylinder and fit a new piston and rings for 15s. No doubt this seems a ridiculous price nowadays, but you got more for your money then. So I sent them my cylinder and piston, which probably surprised them a lot, and in due course it was returned nicely ground and with a new cast-iron piston.

Before fitting the cylinder, the old tin water jacket was removed and a very neat one fitted, all complete with outlet and inlet pipes and properly closed in at the top so that it could be connected up to a cooling tank by rubber tubing in the usual way. It was made of brass tube, with annular sheet brass ends, all well sweated to the cylinder with soft solder.

After a few more trial runs, the plug showed definite signs of sparking in the wrong place when tested, and I realised where the real trouble lay; but about this time I left home to serve an engineering apprenticeship on Clydeside, and nothing more was done to the engine for quite a period.

Nevertheless, it was not forgotten, and as my new environment gave me opportunities which were not previously available, or even thought of, it was quite natural that when I came home on holiday about a year later, I brought with me castings of a newly designed cylinder-head and a new crankcase.

The patterns and castings had been obtained in the usual manner well known to apprentices who happen to be keen on a little private engineering, and who are able to make a friend of the night-shift under-foreman in the foundry.

As I had also become the possessor of a $3\frac{1}{2}$-in. Drummond lathe, it was not long before the new castings were machined up, and the engine was ready to try conclusions with the dynamo once more.

The new cylinder-head was of queer design Fig. 6 shows it in some detail, and Fig. 5 is a photograph of the actual head itself as rescued from the junk box after many years.

The design is peculiar, to say the least, but it was based on the requirement that a full-sized 18-mm. plug must be used, and the valves must not be reduced in size below the originals.

Of course, the inlet valve is much masked by being at the bottom of a deep recess, but at that time the fact did not worry me unduly, so long as I had a free and unobstructed exhaust. It was not until many years later that I came to realise that the inlet was much more important than the exhaust; and in any case, my valves were at least

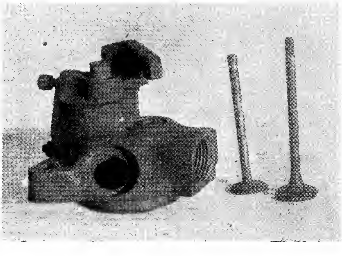


Fig. 5. The second cylinder-head with valves

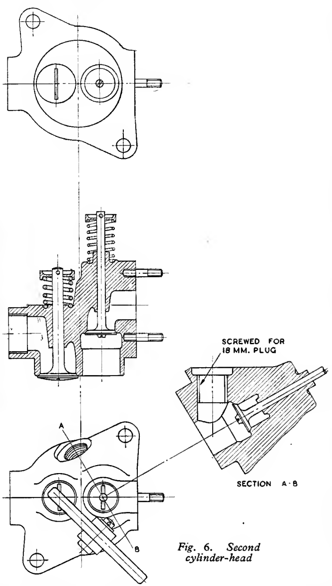


Fig. 6. Second cylinder-head

the fresh mixture at every stroke, and, therefore, could hardly fail to fire it.

The new cast-iron crankcase was of circular pattern, with supporting feet cast on at the bottom, and the timing side was provided with suitable bosses for the timing gear, as well as a lubricator plug and a drain hole.

The crankshaft bearing bosses were increased in size, in case it was decided in the future to fit a stiffer crankshaft.

This was a wise provision, as it turned out, for very soon afterwards, the crank again broke in much the same place as before, but due on this occasion to pure weakness and not to a jam-up.

I decided to scrap the old flywheel, which was really too heavy, and fit a spoked cast-iron one, which I got from Stuart Turner.

This was about 8 in. diameter, and proved to be on the light side, but it was the biggest casting they had which would swing in the gap of my Drummond. Its main advantage was that it ran true when fitted.

The new crankshaft was $\frac{7}{16}$ in. diameter on all the journals, and was made from a mild-steel casting, bought from an advertiser, in order to save the time in getting another forging.

It machined to a beautiful finish, and I made a nice job of it, polishing the webs all over, so I was more than disgusted when it broke right through the crankpin, after about an hour's running. No other damage was done, as the long main bearings kept the shaft in position, in spite of the break, and only a slight wobble of the flywheel betrayed the fact that something was amiss.

This calamity was a severe blow, as the engine was now running very well; an old Longuemare carburettor had been fitted, and a complete new

twice as large as was needed for the speed at which the engine was capable of running.

At any rate, whatever its defects may have been in the light of modern knowledge of cylinder-head design, it gave me great satisfaction at the time, as the previous persistent misfiring became a thing of the past.

In fact, the engine could be throttled down to run light, with the ignition well retarded, until the flywheel gave a perceptible pause at the end of the compression stroke and it would continue to idle round in this fashion as long as desired.

This even firing at slow speeds was due, no doubt, to the fact that the plug was swept by all

timing gear and exhaust cam had eliminated a lot of the previous clatter.

A long time was to elapse before repairs could be made, as just at this time the 1914 war broke out, and I went off in a hurry so as to get a free trip with the others to Berlin before Christmas.

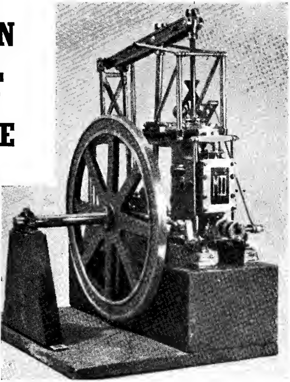
During the war, our home was moved from London, and during one of my leaves I managed to ensure that my engine was packed up, with the lathe and the rest of the workshop equipment, instead of being thrown away.

(To be continued)

EXHIBITION MODELS AT SWADLINCOTE

THE second annual exhibition of the Swadlincote and District Society of Model Engineers was held on November 20th, 22nd and 23rd, in the Wesley Schoolroom, Swadlincote, which is just twice the size of last year's hall; no difficulty was experienced, however, in obtaining sufficient models to put on an excellent show which, judging from reports since received, was enjoyed by a great number of people.

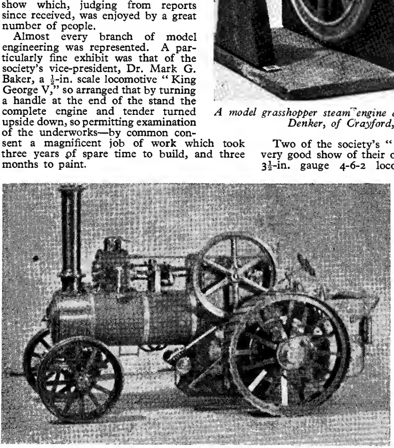
Almost every branch of model engineering was represented. A particularly fine exhibit was that of the society's vice-president, Dr. Mark G. Baker, a ½-in. scale locomotive "King George V," so arranged that by turning a handle at the end of the stand the complete engine and tender turned upside down, so permitting examination of the underworks—by common consent a magnificent job of work which took three years of spare time to build, and three months to paint.



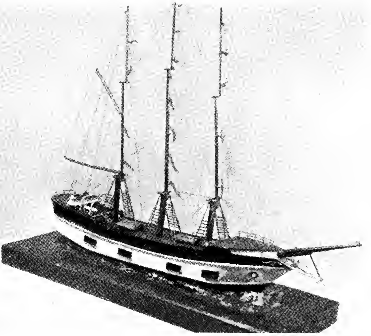
A model grasshopper steam engine exhibited by Mr. M. Denker, of Crayford, Kent

Two of the society's "star turns" put up a very good show of their own, Mr. F. Knowles' 3½-in. gauge 4-6-2 locomotive chassis, and horizontal and vertical steam engines were very much admired, and Mr. E. Banner's mill engine and "Kittiwake" petrol engine were a centre of attraction, particularly the latter, when running. The Aero Section was extremely well represented; members in this section are all under 16 years of age, and some very fine work was to be seen.

Other exhibits ranged from a 4-ft. high working pit-head gear with a beautifully - made colliery winding engine to a tiny electric motor which was fitted



A 1-in. scale traction engine exhibited by Mr. F. Read, of Nottingham



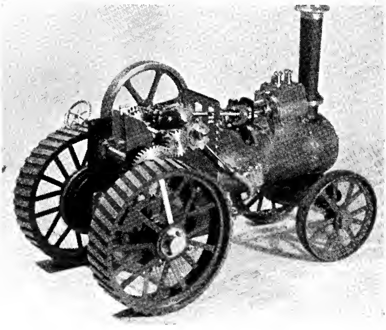
A model 3-masted barque exhibited by Mr. R. Hodgkinson, of Kegworth

into the nose of a 6-in. wing span aeroplane and driven by a No. 8 dry battery; the former was built by the late Mr. Mansfield, the latter by a very active member, Mr. T. Gardiner. Members of the Nottingham, Derby and Leicester clubs very kindly gave their support with a grand selection of models, which included the winner of the cup for the best in the general section in 1939, at Nottingham, and winner of the bronze medal in the same show. The cup winner, a 1-in. scale "M.E." Traction engine is a wonderful example of the model-maker's art. The bronze medallist, a 30-c.c. o.h.v. petrol engine by the same Nottingham member, Mr. Tillson, of Long Eaton, is also a very fine effort, and both were admired by many enthusiasts.

Another 1-in. scale traction engine, this time by "Lone Hand," Mr. F. Read, of New Sawly, excited a lot of comment on the reproduction of the many details in so small a space, and all were strictly to scale; without doubt, a beautiful piece of work. Mention must be made of the ladies of the club, who turned up in force to dispense tea and cakes on the Saturday afternoon.

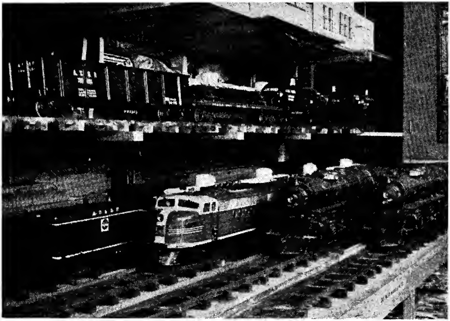
The final results are most gratifying, exceeding all expectations.

The photographs are by Mr. A. Benson.



A 1-in. scale "M.E." traction engine (unfinished), exhibited by Mr. Tillson, a member of the Nottingham S.M.E.

* *The*
# HOWARD BROTHERS



Santa Fe LINES

(7) "*Wildwood Station*" *with a streamliner just arriving. In the foreground are the village smithy, bandshells, and a couple of stores*

(8) *The ½-in. scale models of Santa Fé locomotives all powered by electricity. Left to right, diesel "donkey," diesel-electric streamliner, and two steam locomotives. On shelf above is some of the freight rolling stock*

(9) *Wildwood Village from across the station. A freight train is passing "Mission Junction" in the background. The village farms and pond are in the centre*

**Continued from page* 11, "*M.E.*," *January* 2, 1947.

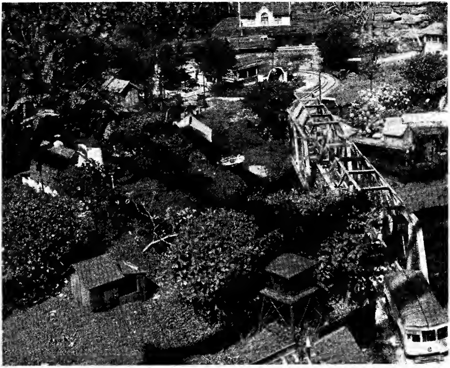
VOLTAGES range from 6 volts for lighting and operation of crossing equipment, 24 volts d.c. for the operation of the trains to voltages of several hundred in the electronics of the system, and either a.c. or d.c., as the equipment requires.

A display is kept for the enjoyment of visitors to the Howard home on Jefferson St. in Pomona, California, in a garden 30 by 25 ft. (This is the display in the photographs.) It is a permanent set through the four seasons, while the balance of the display is shown at state and country fairs across the country (United States). It is estimated that over two and one half million persons of all ages have seen this display run at the Los Angeles County Fair, Pomona, California, home of the Howard brothers. The model railroad not only attracts children, but grown-ups are just as enthusiastic over the realistic models.

All names of villages are imaginary, although memory copies many scenes of childhood days. The name of the principal settlement, "Wildwood," was so named because the first hymn to be heard from the village church by electronics was "The Church in the Wildwood."

All rolling stock is from actual blueprints furnished by the Santa Fé railroad, and enough scenery is in storage to build any type set that is to be found along the far-flung miles of this great railroad.


SIGNS



(10) *A model Santa Fé streamliner stops at the station in the model village of Wildwood. The village was named Wildwood because " The Church in the Wildwood " was the first music to be played over the loudspeaker in the model church. Village modelled after New England villages*

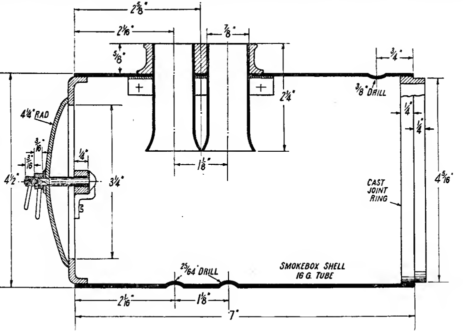
(11) *H. R. Howard and the power supply for the model trains and villages. Lower left is the charging unit for the batteries. Centre and lower right, switching panels. Upper right, the sound system for "piping" music and sound into the model churches and trains*

(12) *View of model village of Wildwood, showing the village church, stores, park, blacksmith, farms, street car, horse-drawn carriages, and railroad station with model streamliner passing by. It is 25 ft. from the extreme foreground to the station in the rear*

"L.B.S.C."

"HIELAN' LASSIE'S" SMOKEBOX

THE best thing for the barrel of the smokebox is a piece of 16-gauge brass tube, 4½ in. outside diameter, to finish to 7 in. length. It doesn't matter a bean whether it is best quality seamless, or common brazed-joint stuff; also, any thicker gauge could be used, or even slightly thinner, though I shouldn't recommend anything less than 18 gauge, on account of making it on the weak side. Other materials can be used; copper tube will do as well as brass, but it costs more. Steel makes a good smokebox, as long as no water is allowed to remain in it. It naturally gets well heated, and remains free of water all the time the locomotive is at work; but when the fire is dying



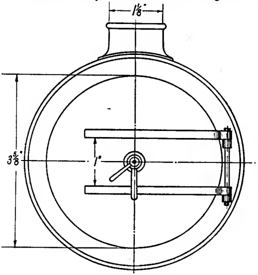
Smokebox for "Hielan' Lassie"

out at the close of a run, and the engine is using up her last few pounds of steam, you get a white cloud from the exhaust, and some of it condenses in the now cooled-off smokebox, wetting the ashes in the bottom, and wet ashes are a fine thing to start rusting and pitting. The original "Maisie's" smokebox was made from a piece of steel tube, ⅛ in. in thickness, which I happened to have in stock. "Bill Massive" wanted a steel smokebox, and he got one, which certainly was inclined to be massive!

If tube should be hard to get, or even unobtainable (though it shouldn't be as bad as that), don't worry; roll up a bit of sheet metal to the diameter required. Butt the edges together, rivet a strip inside about ½ in. wide, and silver-solder the joint, if brass or copper. If steel, you needn't bother about a butt strip at all. Just slightly bevel the edges where they come together to form a vee, and either braze, Sifbronze, or fusion-weld the seam, according to your ability and equipment available. My own preference is Sifbronze. The Suffolk Iron Foundries Ltd., of Stowmarket, who are the makers of that ubiquitous commodity, issue a little quarterly publication called "Sif-tips," which they send out regularly to all interested Sifbronzers. There are two "characters" in it, Will and Winnie, who describe and illustrate regular engineering jobs by Sifbronzing; and also another known as George, who is a "daddy" with an oxyacetylene blowpipe. This merchant looks on Sifbronze pretty much the same as the cure-all remedy sold by the gentleman who has "stood in this market place for forty years," and uses it for every repair he comes across, mending a pair of steel spectacle frames, the baby's pram axle, lawn mower and garden tools, the family wringing machine, the carving fork, sundry jobs on the gasoline chariot, and so on and so forth. I'm afraid I must confess that Curly is another one of the same kidney, and if there is anything that wants sticking together, and a spot of Sifbronze will do it, well—Sifbronze does it, and that's that! It is hardly necessary to add that

after cutting out the frames of the Brighton single-wheeler "Grosvenor," which I did on my milling machine, using a 4-in. cutter as a circular saw, they were promptly Sifbronzed into the slots in the buffer and drag beams, in less time than it would have taken to cut out and rivet on one piece of fixing angle. Time is very precious nowadays!

Square off both ends of the smokebox barrel in the lathe. If made up from sheet, see that it is nicely rounded. Beginners note: if you drive a circular piece of wood or metal into the end, grip in three-jaw and set to run truly; the outer end can be squared off without any extra support, as the chuck jaws can be tightened down on the barrel without crushing it. Take light cuts with a roundnose tool set crosswise in the rest. Next, mark off the holes for chimney liners, snifting valve and blast pipes. Scribe a line along what will be the top of the smokebox, and make centre dots at $2\frac{1}{16}$ in. and $3\frac{3}{16}$ in. from the end, also another at $\frac{3}{4}$ in. from the other end. To get the holes for blastpipes diametrically opposite (aren't I getting posh?) I use a flexible steel rule which is easily wrapped around the shell, and indicates the exact diameter, so that it is easy to mark off half the amount, and scribe another longitudinal



Smokebox front

line, on which the distances are set off as shown. If you haven't a flexible steel rule, borrow your fair lady's measuring tape, with a solemn promise not to make it dirty; very important that! Drill all the holes first with a No. 30 drill; then, by poking a piece of $\frac{1}{8}$-in. silver-steel (which is usually straight and true) through the liner and blastpipe holes, you can see if they are opposite to one another. If not, correct with a rat-tail file before enlarging the holes to the sizes given. The holes for the liners should be opened out in two stages, finally being drilled 55/64 in. and reamed $\frac{7}{8}$ in. Beginners should, after centre-popping, scribe a $\frac{7}{8}$-in. circle at the location of each liner hole, which will help them to detect any wandering of the drill from the straight and narrow path.

Chimney and Liners

The chimney is a double stovepipe containing two liners made from $\frac{7}{8}$-in. brass or copper tube, 18- or 20-gauge. Cut two pieces and square them off to a length of $2\frac{1}{4}$ in. in the lathe. Soften them, and bell one end of each slightly, as shown; this can be done by driving in a piece of shaped metal or hardwood, or holding them against the edge of a block of lead and making judicious use of the ball end of the hammer head. Cut a piece of 16-gauge sheet brass or copper, 3 in. long and 2 in. wide. Scribe a line down the middle, and set out and drill the two holes for liners, same as described above. Leave the holes slightly small, so that the liners will fit tightly. Bend the piece of metal to the same radius as the inside of the smokebox. Push the liners through from the concave side, so that they are square with the plate, and parallel to each other, projecting $\frac{11}{16}$ in. above the plate; then silver-solder them, using the merest touch of silver-solder on the concave side of the plate, so that there will be nothing on the convex side to prevent it bedding truly against the inside of the smokebox. Put a smear of plumbers' jointing around each liner where it projects through the plate, then insert the whole doings in the smokebox. The liners should go up through the holes in the smokebox shell and the plate fit snugly against the inside. Drill a No. 41 hole at each corner, clean through shell and plate; countersink on the outside, and secure with brass countersunk screws (3/32-in. or 7-B.A.) nutted inside the smokebox.

As the liners never have to be removed for anything in the ordinary way, they can, if you so desire, be fixed without a plate at all. Simply push them through the holes in the shell, so that they are square with it, parallel and true, and project $\frac{5}{8}$ in. Then silver-solder them to the shell. I usually do it that way. On "Tugboat Annie," which has a single large-diameter chimney standing only $\frac{1}{4}$ in. above the smokebox (bless those bridges and tunnels!), the liner was pushed through the hole in the crown of the smokebox as above, a flange of 16-gauge metal dropped over it, and a ring of 3/32-in. half-round wire placed on top; a gentle application of the blowpipe, and hey presto! we had a nobby-looking doings which was ample for the grate area (and it is great, at that!) and not even Inspector Meticulous himself has found any fault with its personal appearance.

The chimney casting, which our advertisers will be able to supply, will have two cored holes in it. Check these off to make certain that the centres are right, viz., $1\frac{1}{8}$ in. apart, and that they are on the longitudinal centre-line of the casting; then chuck in four-jaw, base outwards, and bore out each hole until a piece of $\frac{7}{8}$-in. tube will just push in. The base can be radiused out with a flycutter. This is simply a roundnose tool made from a bit of $\frac{1}{4}$-in. round silver-steel about 3 in. long. For a holder get a bit of round mild-steel somewhere around $\frac{3}{4}$ in. diameter, if your three-jaw has a centre hole which will take that size; if not, then use the biggest that it will take. The piece of steel should be about 5 in. long. Drill a $\frac{1}{4}$-in. clearing hole crosswise through it about $\frac{1}{4}$ in. from the end, and drill and tap the end for a $\frac{1}{4}$-in. setscrew. Poke the tool through the crosshole, so that

the cutting edge is $2\frac{1}{4}$ in. from the centre of the holder, and secure it by the set-screw; if you grind a flat on the side of the cutter, the set-screw will get a better grip. Chuck the holder in three-jaw with the cutter overhanging about 3 in. Clamp the chimney-casting under the slide-rest tool holder, level with centres and parallel to bed. Have the lathe running fairly fast; feed the casting into cut with the cross-slide, and then work it back and forth, parallel to lathe bed. The flying cutter will then machine off the base exactly to the curve of the outside of the smokebox. Warning—mind your fingers! As about the only type of lathe which would machine the outside of the casting true to profile would be a Blanchard copying lathe, and you don't find *those* in home workshops, the only way to clean up the outside of the casting is by the good old file-and-emerycloth stunt.

Smokebox Front and Door

Castings will be provided for these, and very little machining will be needed. If the hole in the front, or ring, as it is usually called, is clean cast, it need not be touched; although builders who are a bit fussy may, if they so desire, chuck the casting in three-jaw, or mount it on the faceplate, and bore the hole truly. They can then rechuck, with the bored hole on the inside jaws, and turn the front and the flange at the one setting. An alternative, and perhaps easier way, especially for beginners, is to put the outside jaws in the chuck, and mount the ring on them, gripping by the inside of the flange. The whole front can then be faced off with a round-nose tool set crosswise in the rest, and the flange turned to a tight push-fit in the smokebox shell. The edge should have a good radius. An old flat file with a semicircular "bite" ground out of the end is a good tool for this job. Use it as a hand tool, resting it on the shank end of a tool projecting from the side of the slide-rest tool-holder, if you haven't a proper hand-rest. I keep a few old-fashioned hand tools (graver, point, round-nose, radius, and right- and left-hand hooks) always ready for use, and often find them handy for finishing off various oddments which would otherwise entail a lot of judicious twiddling of slide-rest handles to produce the same contour, e.g. the top of "Jeanie Deans's" chimney with the undercut lip so beloved of locodelineator F. C. Hambleton. I took special care with that, just to show how I appreciated his excellent drawing.

The door will have a chucking spigot in the middle of the outside, which can be held in the three-jaw, and the edge and contact-face turned at the one setting. You can't turn the outside, on account of the cast-on hinges, so the files and emerycloth will have to come into operation once more. While chucked, centre, and drill a $\frac{3}{16}$-in. hole through the middle of the door; reverse in chuck, holding in the outside jaws by the edge, part off the spigot and face the boss truly.

The ring and door may, if desired, be knocked up from brass blanks, or discs cut from $\frac{1}{8}$-in. sheet brass, the ring needing a circle 5 in. diameter, and the door $3\frac{3}{4}$ in. I have already described the flanging and dishing processes for various other engines described in this series; machining is carried out as above, a chucking-spigot being turned from $\frac{1}{2}$-in. round brass rod, and soldered to the concave side of the dished and drilled door blank, so that the outside can be turned and the contact edge trued up at the one setting. The hinge straps are made from pieces of 18-gauge strip steel, brass or nickel-bronze; the ends are bent into eyes and silver-soldered, the hinge straps being riveted to the door by bits of domestic pins. The built-up work looks nice if carefully done; but life is short, and good castings eliminate a lot of time-absorbing labour!

Dart and Crossbar

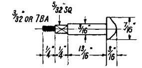
The dart is made from a bit of $\frac{7}{16}$-in. round mild-steel chucked in three-jaw. Face the end, and turn down $1\frac{5}{16}$ in. length to $\frac{3}{16}$ in. diameter; further reduce $\frac{1}{4}$ in. of the end to 3/32 in. diameter, and screw it 3/32-in. or 7-B.A. The next $\frac{1}{4}$ in. is filed square. Part off to leave a head $\frac{3}{16}$ in. wide. File it flat, flush with the $\frac{3}{16}$-in. stem, and then shape it as shown in the illustration. The key is a $\frac{3}{16}$-in. slice parted off a piece of $\frac{5}{16}$-in. steel rod; drill a 5/32-in. hole through it and file it square to fit the squared part of the dart. The locking-nut is a $\frac{3}{16}$-in. length of $\frac{3}{16}$-in. steel rod drilled and tapped to suit the thread on the end of the dart. Both are drilled through the side with a No. 48 drill at a slight angle, tapped 3/32-in. or 7-B.A., and have pieces of 3/32-in. silver-steel screwed in, for use as handles. Round off the outer ends, or you'll be hearing a few compliments from the driver and fireman!

The crossbar is a simple job. Cut two pieces of $\frac{1}{8}$-in. by $\frac{1}{4}$-in. mild-steel, each 4 in. long; clamp together, and drill a No. 41 hole $\frac{1}{2}$ in. from each end. Chuck a bit of $\frac{1}{4}$-in. round rod in the three-jaw; face, centre, drill No. 41 for about $\frac{3}{4}$ in. depth, and part off two $\frac{1}{4}$-in. slices. Put them between the bars, opposite the holes, to act as spacers; poke two 3/32-in. by $\frac{5}{8}$-in. iron rivets through the lot, and rivet up. Nobody ever sees this component, so there's no need to worry about exhibition finish!

The crossbar is supported on two brackets made from strips of 16-gauge sheet-steel, $\frac{1}{4}$ in. wide, attached to the inside of the smokebox front by a single 3/32-in. screw in each; see section. The location of these is obtained from the actual job. Put the dart through the hole in the middle of the door, with a $\frac{3}{16}$-in. steel washer on the outside, then the key and locking handle. Put the door in position on the ring, put the crossbar over the head of the dart on the back of the ring, adjust it so that it is centrally located across the "big hole," and tighten up the locking handle. Check off to see if the door is still in the middle of the ring; if so, set your brackets up against the underside of the bar, mark off the screwholes, drill and tap them, and put the screws in, filing off any projection on the outside of the ring.

Turn the whole issue over, and mark out the position of the hinge lugs under the bosses on the ends of the straps; see front view. Centre-pop $\frac{1}{16}$ in. below the straps, drill No. 44 and tap 6-B.A., or No. 40 and 5-B.A. The lugs themselves are another kiddy's practice job. Chuck a bit of $\frac{1}{4}$-in. by $\frac{1}{8}$-in. rod truly in four-jaw, turn down the end for $\frac{1}{8}$ in. length to 7/64 in. or $\frac{1}{8}$ in. diameter, according to how you tapped the holes,

and screw it to match. Part off $\frac{1}{4}$ in. from the shoulder. Round off the ends with a file, remove door, and screw in the lugs. Drill the bosses on the ends of the dummy hinge straps on a cast door, with No. 48 drill; if the door is built up, the bosses won't need drilling, as they will be formed by the bent-round ends of the straps themselves. Replace door, and screw it up in its



Dart

proper position; poke the 48 drill down the holes in the bosses, and carry on through the lugs. The hinge pin is a piece of 15-gauge spoke-wire or silver-steel, with the end slightly riveted over so that it won't fall through. If you want an extra posh appearance, screw a weeny bit of steel rod on the end, and turn it into a little flat head as shown in the illustration. Don't put the completed ring-and-door assembly in the front of the smokebox "for keeps" yet; this can be done after the boiler is erected and all the steam pipe connections made inside the smokebox, which is easier work with the front unobstructed.

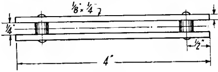
Joint-ring

Castings will be supplied for the joint-ring, which is merely a ring $\frac{1}{2}$-in. wide, turned in two steps. If your chuck isn't big enough to hold it on the largest diameter the inside jaws will take, put the outside jaws in, and hold the casting on the outside of those, similar to the recommended way of holding the smokebox front. The two steps can be turned at the same setting. Use a roundnose tool first, and turn the whole outside surface of the ring to fit tightly into the smokebox barrel, the diameter being approximately $4\frac{3}{8}$ in. Then take another 1/32 in. off half the width with a knife tool, to fit the end of the boiler barrel, which should be $4\frac{5}{16}$ in. If turned at the same setting, the steps should be exactly concentric; and when boiler and smokebox are connected, they should line up exactly.

"Juliet"

Displacement Lubricator

Beginners who are shy of tackling the job of making a weeny mechanical lubricator can use the simple displacement pattern shown in the assembly view of the steam and exhaust connections, illustrated along with the last notes on "Juliet." A displacement lubricator works very well if the screw-down valve is properly adjusted; its principal failing is a tendency to "gulp." The cause of this is easily explained; for beginners' benefit I will repeat that when the engine is running there is naturally the same pressure in the lubricator tank as in the steam-chests. When the regulator is suddenly closed, steam pressure in the chests falls to "below freezo," as the kiddies would say, on account of the pumping action of the pistons; and the pressure in the lubricator immediately forces out any oil above the outlet, into the steam-chests, helped in its nefarious work by the partial vacuum in same. As soon as the regulator is reopened, the surplus oil in the steam-chests is shot out of the chimney with the exhaust, and the driver usually gets a free and unsolicited beauty treatment. Engines provided with snifting valves are not so bad as those without, as the pistons do not suck the oil;



Crossbar

but the pressure in the lubricator still takes action. The provision of a check-valve between lubricator and steam pipe is a doubtful remedy, as the valve frequently sticks on its seat and prevents oil reaching the cylinders when running. However, if the lubricator valve is carefully adjusted, gulping can be greatly reduced; and careful handling of the regulator can make it negligible.

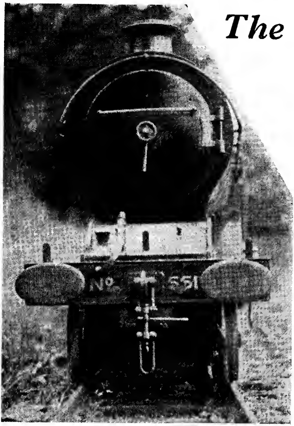
The oil tank is simple a piece of $\frac{3}{4}$-in. copper tube, about 20-gauge, squared off each end in the lathe to a length of $2\frac{7}{8}$ in., with a 16-gauge sheet-copper disc driven tightly into each end. A $\frac{3}{16}$-in. hole is drilled right across the middle; a $\frac{1}{4}$-in. hole in the top, and a $\frac{1}{8}$-in. hole in the bottom. A $1\frac{1}{2}$-in. length of $\frac{1}{4}$-in. pipe, with a few threads on one end, is pushed into the top hole. A bent piece of $\frac{1}{8}$-in. pipe, also with a few threads on the end, goes in the bottom hole. The valve goes through the middle. To make it, chuck a piece of $\frac{3}{16}$-in. brass rod in the three-jaw, face the end, and part off a piece $1\frac{1}{8}$ in. long. At $\frac{1}{2}$ in. from one end, drill a 3/32-in. hole right across the middle. Chuck in three-jaw with the short end outwards; centre and drill with No. 55 drill until you break into the cross-hole. Let the drill go on into the other side for about $\frac{1}{16}$ in. or so; then open out with No. 48 drill as far as the cross-hole, and again with No. 41 for about $\frac{1}{4}$ in., to give clearance for the valve pin. Tap the remains of the No. 48 hole with 3/32-in. tap, letting same run into the cross-hole. Screw the end about $\frac{3}{16}$ in. down, with $\frac{3}{16}$-in. by 40 die in tailstock holder.

Reverse in chuck; centre deeply, and drill down with No. 40 drill until you meet the 55 hole. Take great care not to "overshoot the platform," and break into the cross-hole, or it is good-bye to the valve-seat, and the ceremony thus far will have to be repeated. Put about $\frac{3}{16}$ in. of outside thread on this end also. The valve pin is made from 3/32-in. round steel; either rustless- or silver-steel will do; in fact, it doesn't matter if bronze, or even brass, is used, as the valve, once correctly set, need never be altered. Screw it for about $\frac{1}{2}$ in., with a 3/32-in. die in the tailstock holder; then turn away the threads for about $\frac{3}{16}$ in., and form a cone point on the end. This needn't be turned; a couple of sweeps across the end, with a fine file held at an angle of about 45 deg. makes a perfect point. I've made scores of them that way. Cut off the pin about $\frac{7}{8}$ in.

(*Continued on page* 132)

The Professional Call

By H.J.H.



A first impression

IT was late summer when the writer longed for a restoration of those powers of keen penetration into mechanical problems in order not to betray the confidence placed in him. He had been asked for an opinion on a valve-gear. Really, there was no need to worry, for the commission was a friendly arrangement and just the opportunity to arouse a dormant sensorium. In any event, if it wasn't convenient one need only 'phone Hackworth 1859, or whatever it was.

If the call number was anything to go by, some revision of radial gear matters was indicated. As no drawings of the gear to be inspected were available and indicator diagrams could not be taken, it was obvious that technical experience applied to present observation was the only course practicable in the initial tests. Later, during winter overhaul, it might be possible to measure components and subsequently plot point paths and study static and dynamical matters.

At the Depot

Reporting for duty witnessed a really handsome locomotive on a $7\frac{1}{4}$-in. gauge track, and the coupling-up of the C.M.E.'s saloon. The very atmosphere was stimulating to anyone interested in railways and their equipment. His nobs was "riding the plush." With the grace that befits one who can boast the wisdom of two summers within the ambit of eighteen months of life, he extended a warm welcome to the staff and others to join him. Thus it was that the writer's first few trips were made on the vehicle next to the engine. The riding was very good and the runs were a pleasant prelude to the more important ones to come.

"'Ave a go" was the signal to seek more austere accommodation and place oneself at the controls and be alert for observation. Then followed a few preliminary tests to get the feel of the engine and, incidentally, a liking for its general behaviour. Acceleration was good, firing was a steady job and for a small machine it called for comparatively little consideration. Some engines are nerve-racking to drive, but it was plain to see that the present engine would not readily run short of steam.

On the Road

She responded beautifully and with stops disposed of, it was not long before speed began to rise and one could watch the panorama sweep by and take notice of lineside objects and noises. The rumble in cuttings, the cough of an overbridge and the reflection of sound from nearby trees were all there, just as in full-size working. It was great! In the symphony of locomotive harmonies were the chuff chuff at starting, the chucker chucker as the engine got into its stride, and the gurgle of the injector. All so very different from the roar of overhead or elevated lines and one doesn't realise what is missed, until one tries a ground-level track with civil engineering features adding to the interest.

It makes one feel determined to plan sounding-boards and other acoustical stunts alongside an elevated line to vary the tone and so relieve the monotony. Anyway, whoever really got tired of driving a small locomotive?

Tea and a vacuum induced a visit to the house; and so the fire was banked up under a filled boiler and the engine left to itself for a short time.

After tea, there was time for further trips and mine host found it more opportune to demon-

strate the engine. She was running well and purring away up the inclines. At one spot on a slight rise and through a 60-ft. radius curve she went as smoothly as a racing car on a banked track. Probably the visitor never attained such speeds, but by now he, certainly, had gained the confidence needed to let her have her head, even at dusk.

Night Express

Ever tried driving at dusk to dark? It adds to one's memories. Imagine yourself driving and trying to keep her quiet and coal has been put on so that the blast will draw up the fire again as the bank is climbed. The engine is forging ahead into the dusk; steam and smoke are curling back to add joy to the proceedings. Then, as the bank is struck at the bottom of the cutting near Bylawn Bridge, thunder breaks loose as the regulator is opened more. The beats become more determined, whilst the exhaust rockets up hoarsely from the chimney. The grade is 1-in-38 easing to 1-in-60.

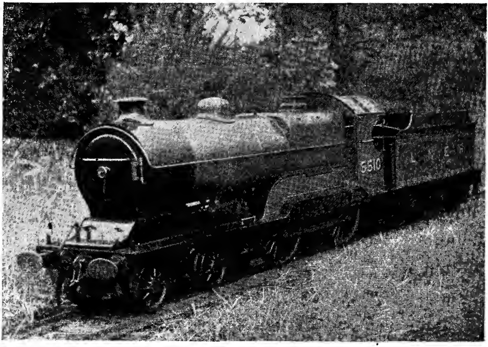
She's chugging away and each chuff is having its effect on the fire—the glow from which is pulsating and getting brighter as the bank is climbed. It causes one to gaze at the crevices around the firedoor thrilled and fascinated. There goes the overbridge at Porch Point, judging by the sound, for one just can't see ahead in the cutting. But there's a chance for a quick glance across the curve at the top of the bank before a headlong rush through Stonewall Junction.

The curve looks extraordinarily sharp as it is approached, and now that the crest and cutting are cleared speed is mounting and the track gleams ahead in the half-light. A whistle for the junction in accordance with rule 147 and there's a muffled rumble as the track and junction peal away. The exhaust is less obtrusive now and just whispers from the chimney. A glance back at the cavalcade of cars snaking around the bend. We're in the open now, soft breezes are fanning by and the night air has increased the reverberation from the trees. Yes! it all sounds different from daylight running.

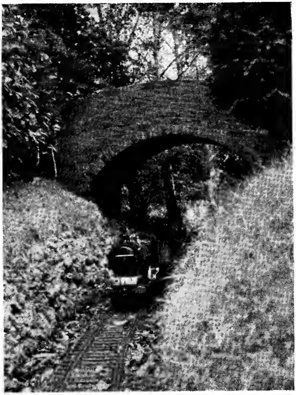
Watching the locomotive work from the cab is very fascinating and one can enjoy to perfection the sight and feel of the engine tackling the job of curves and grades. This is the last trip of the day and so terminates at Northbank instead of running through to Westview, which is noted for its vistas of Dorset Hills and Wiltshire Downs. With fire low and injector working to fill the boiler ready for the sheds, the brakes are applied and retardation effected just at the prescribed point. As the fireman prepares to change the classification lamps a voice hails through the darkness, "Well! what have you found?"

Liquid Fuel

That call, which bore no anxious tones, was directed at the writer. The report on the valve-gear question must remain a confidential matter between "client and consultant," but it need be no secret that the main topic for conversation that evening related to liquid fuel for locomotives.



A J. S. Beeson product of 1938 which has its home shed in the West Country



At Porch Point

The charms of steam have no rival in our sphere of activity, but there is a little anxiety as we turn our attention to oil-burners on the basis of necessity rather than economy; that is, as it affects the larger miniature locomotives. The position appears so antithetical after having striven in recent years to break away from liquid in favour of solid fuel.

Be not depressed, however, as there is a new field to conquer—spray burners in place of the vaporising type and the utilisation of more viscous fluids than hitherto employed. Model engineers have not neglected this subject, but there has been very little development. A fairly up-to-date effort was reported in the issue of November 28th, 1935.

It is, indeed, fortunate for us that the locomotive type of boiler has proved adaptable for oil-firing. Maybe, on our small editions we shall follow the full-size convert in needing a relatively sharp blast to obtain free steaming. We shall see, in due time, and be able to compare results with the vaporising forms which seem to favour a blast softer than customary on a coal-fired engine. Such points as firebrick protection and ensuring complete combustion before the flames reach an impact surface need to be taken into account. The chief advantage of oil fuel is its favourable calorific value and enhanced evaporative power. But all the gain may not be realised owing to the need, in certain cases, of providing steam to operate the burners.

Provided that the mechanics of an oil-burning system are planned on the right lines, success should be possible. On the subject it would be nice to have a symposium similar to the one we had a few months ago on ground-level tracks.

The little $7\frac{1}{4}$-in. gauge tank engine which was illustrated on page 491 of volume 93, will now come into its own as an experimental unit for trying out various oil burners and to ascertain if water tubes are desirable in the firebox when liquid fuel is used.

These experiments are a complement to the 101 other things that can be tried out. Has anyone yet tried "cab travel" in sub-zero weather, for example? It would be interesting to see what happens, for, presumably, efficiency drops considerably if only because incoming air has to be heated up to combustion temperature, not to mention the extra radiation losses. Our subject is not exactly off the track, but——

The day's work was done and, lulled by various rhythmic engine noises, sleep followed in the beautiful setting of a friendly world of locomotives. Should you consider the title of this article presumptuous, try and picture the emotion at the outset; and should your forgiveness be forthcoming, attempt its expression as a contribution to the suggested symposium. It would be most welcome.

"L.B.S.C."

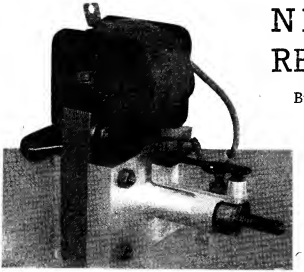
(*Continued from page* 129)

from the point, and file a square on the end. This is furnished with a little handwheel, $\frac{3}{8}$ in. diameter, turned from $\frac{3}{8}$-in. brass rod; another kiddy's practice job needing no description, as is also the little gland nut made from $\frac{1}{4}$-in. hexagon rod.

All the joints—ends, valve, and top and bottom tubes—can be silver-soldered at one heat. Pickle, wash off, clean up, and pack the little gland with a strand of graphited yarn. Attach the lubricator to the $\frac{1}{8}$-in. pipe with union nut, projecting from the front of the steam tee, as shown in the assembly drawing; the tank should fit tightly between the frames. It may be held by a $\frac{1}{8}$-in. set-screw running through a tapped hole in the frame at either side. All that remain are two little caps as shown in the illustration, one made from $\frac{5}{16}$-in. hexagon rod, for the filling tube, and one made from $\frac{1}{4}$-in. ditto, for the drain pipe.

NEW YEAR RESOLUTIONS

By Edgar T. Westbury



A development of the " Atomag Minor " magneto, embodying detail improvements in design

AMONG the many vivid recollections of my schooldays, I recall in particular the greeting of our old schoolmaster, when we returned to school from the Christmas holidays—" Well, children, have you all made your New Year resolutions "—following it up with a sound, but somewhat trite, homily on what we ought to resolve either to do or eschew. The advice given, however good, was unfortunately a little belated, because although most of us had made some very praiseworthy resolutions on New Year's day, they had all been broken long before school started !

It is, unfortunately, all too true that many resolutions share the fate of eggshells and pie-crust, in that they are fashioned with pains-taking care, only to be quickly broken ; but that does not necessarily mean that they are not worth while taking the trouble to make. The navigator who fixes his eyes on the distant star gets farther than he who idly watches odd bits of drifting wreckage. Although the pastime known as wishful thinking has often been condemned, it is only futile when no attempt is made to follow it up by action ; but action without forethought and resolution is just as aimless.

And now, having got this splurge of philosophy off my chest, perhaps we can get down to business. As the New Year dawns on a prospect of unrelenting austerity, restriction and frustration in the ordinary affairs of life, I turn to my model engineering workshop as the only harbour of refuge in an insane and topsy-turvy world. And the question arises, what am I going to do in the workshop during the coming year?

Not that there is any lack of things to do ; on the other hand, there is rather an embarrassment of riches in this respect —so many new problems to be solved, new ideas to be put into practice, that the greatest difficulty is to know where to begin. It occurs to me to commune with readers on the subject, like the late radio philosopher who was often heard to question, " What would you do, chums ? "

In case you retort that this is entirely my own business, I beg to point out gently and firmly that you are wrong. nearly all the work which I do in my own workshop will, I hope, form the subject of future articles in THE MODEL ENGINEER and as I wish these to be as useful and practical as possible to the general reader, it follows that your opinion on the subject is valuable. In other words, your plans are my plans, and my policy will be guided mainly by what you propose or wish to do in the construction and development of model petrol engines during the coming year.

Plans for the Future

Plans, indeed !—many of you may exclaim—haven't we had enough and to spare of 'em ? What with plans and super-plans, plans to supersede plans, and plans to end all plans—why, the world is cluttered up and overflowing with 'em ! To all of which I wholeheartedly agree ; but the trouble with all this orgy of " world planning " is that everybody is making the plans, and nobody carrying them out ! If everyone who made a plan had to set to and execute it, we might begin to get somewhere ; and in this respect, our little scheme is planning with a difference, because whatever we plan must be put into operation by our own efforts.

In the attempt to find out what readers intend or desire to do, I propose to organise an informal little competition, in which a first prize of two guineas, and a second prize of one guinea, will be awarded to readers for the best essays on their future plans in the design, construction and use of model petrol engines. The points to be dealt with are (1) what type of engine do you intend to build, or would like to see described in THE MODEL ENGINEER ? (2) for what purpose do you intend to use it ? (3) What, in your opinion, is likely to be the most popular line of model

petrol engine development in the future, and why? (4) What is your favourite size of engine?

Letters should not exceed 500 words in length, and should be addressed to me at THE MODEL ENGINEER Office, with the envelope marked "Future Plans," to reach me before March 30th.

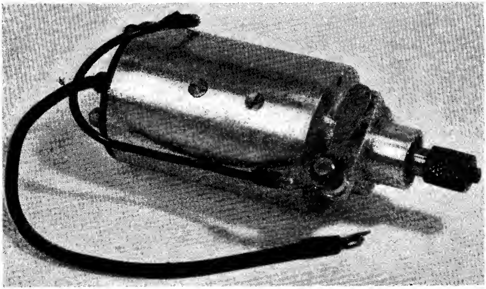
It will be noted that this competition gives scope both for the novice and the expert; one does not need to have an advanced knowledge of design to express an opinion on the type of engine preferred, provided that a good reason can be advanced for this preference. I make no secret of the fact that I have an axe to grind in putting up this competition; my aim is to get a fairly reliable index of the consensus of opinion on these matters among readers, as a guide to future policy. So if you have any ideas, don't hesitate to send them in!

Corrections

It is bad enough to have to beg the indulgence of readers for errors committed; but still worse, I have to apologise for having to make such frequent apologies. In my article "To Boost or not to Boost," in the issue of November 28th last, I made some grievous errors in two of the wiring diagrams, which may possibly have led some of my readers up the garden. These do not affect the particular point at issue, namely the wiring of the booster battery; but the internal wiring of the ignition coil system, which should be identical in Figs. 1, 2, and 3, is shown in the latter two diagrams as having a superfluous connection which completely short-circuits the contact-breaker. Contrary to my general rule of making my own drawings for reproduction, I had on this occasion to call upon the assistance of a colleague, owing to pressure of work, and the errors occurred owing to misinterpretation of my rough sketches. One does not seek to evade responsibility for such mistakes, as the drawings should have been thoroughly checked by me before publication; but in these days when excuses are much more common than the fulfilment of promises, it may be something to know that I have at least a plausible explanation to account for my misdeeds.

Textbook Truth—and Fiction

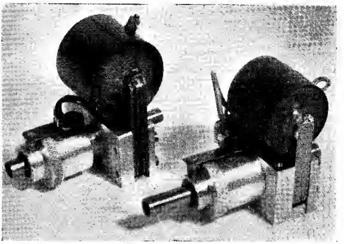
There is perhaps some shred of comfort—if only in a negative sense—in the knowledge that I am not the only writer on technical subjects who makes mistakes. I have recently waded through a book on model petrol engines which is a veritable mine of misinformation. Were one writing a slogan for the publicity "blurb" of such a book, an appropriate one would be "A classic howler on every page!" The writer starts off by getting into a beautiful tangle in trying to explain how an engine works, and makes the remarkable statement that "the piston comes to the top of the stroke *twice* in every revolution!" [The italics and ejaculation mark are mine]. Personally, I have never yet noticed this strange phenomena; but then, I have only seen a few engines! In discussing ignition, it is stated that the spark must be timed "with great exactness" anywhere between two widely separated limits of piston movement; and dealing with lubrication, there appears to be some doubt as to the distinction between castor oil and medicinal paraffin. One gathers that some poor misguided amateurs have attempted to build these small engines, but for the most part have found it far beyond their puny abilities; and that the only type of engine worth considering is the two-stroke, the four-stroke being much too complicated to be successful in a small size.



A self-contained axial or "barrel" type magneto

There are, it is true, some shreds of sound advice in the book, but they want finding; also some fairly good photographs, though they are spectacular rather than informative. The drawings are mostly rather crude, with the exception of those which are obviously obtained from trade sources.

The name of this wonderful book, and its author? Well, I think in this case it is best to adhere to the old army policy of "No names—no pack drill!"—but I will at least set your minds at rest by stating that it is not a British publication, and hardly likely to be turned loose among us in quantity—I hope not, anyhow!



Two miniature magnetos by Miniature Ignition and Accessories, of Ewell, Surrey

Further Magneto Experiments

I am very glad to note that many readers have been able to make good use of the information published in my articles on "Ignition Equipment," and I have had numerous letters from readers confirming the value of this information in assisting them to make their own ignition coils and magnetos. Developments in the latter direction have been very rapid, particularly among readers who have had facilities for making or obtaining special magnets of the latest magnet steels, or special skill in coil winding. As I pointed out in my articles, it is possible to make successful coils and magnetos much smaller and lighter than those which I described in detail, if one enjoys these facilities; and I know of many cases where my best achievements have been substantially improved upon. But I again emphasise that my designs were produced for the benefit of readers of average ability, who are tackling this class of work for the first time; and from the success achieved by many such readers, I have little reason to doubt the correctness of this policy.

Several readers have asked me whether any further developments have taken place in the design of small magnetos, and if so, whether I propose to describe improved designs in the near future. In reply, I may say that I am still carrying out experiments on this subject, but before describing any new magnetos, I wish to be able to ensure that components for constructing them are available. A good deal of trouble and embarrassment are caused, both to readers and myself, when it is found that special materials needed for the construction of magnetos, such as magnets, laminations, coils, contacts, etc., cannot be obtained. I hope to be in a position to straighten out some of these supply difficulties in the near future, but in the meanwhile I would caution readers about accepting components purporting to be of my design, unless they have been tested and reported upon in THE MODEL ENGINEER. At present, I am sorry to say, I have no knowledge of any components for magnetos of my design which I could recommend with confidence.

Two magnetos which are now in course of development are illustrated herewith. The first is similar in all essential points of design to the "Atomag Minor," but by using an improved alloy for the magnet, and also a reduced amount of both iron in the magnetic circuit, and copper in the windings, the bulk and weight have both been materially cut down without affecting performance.

The second magneto represents a further stage in the development of the "barrel" type of magneto, which was described in my articles on "Ignition Equipment," as a type which has certain constructional and installation advantages. This example weighs about 8 oz. complete, as shown, and works quite well, but the electrical efficiency is lower than that of the orthodox type of magneto, a "nigger in the woodpile" which I am not yet fully able to account for, and am at present searching hard to find and identify.

At least one serious attempt is being made to produce really small magnetos commercially, and I have examined two such magnetos submitted to me by Model Ignition and Accessories, 5, Kirby Close, Ewell, Surrey. These are both of the orthodox rotary-magnet type, similar to the "Atomag" series of magnetos, but by using special magnets of high-efficiency alloy, and special technique in coil winding, they have been made very small and light. The larger of the two magnetos weighs approximately 5¼ oz., and is suitable for the larger sizes of aircraft, car or boat engines; the smaller magneto weighs 4 oz., and will thus compare favourably in weight with the lightest battery and coil system.

The frames of these magnetos are machined from solid duralumin, and allow for various methods of mounting; variable ignition timing is provided by an adjustable contact-breaker of the blade type, similar to those which I have

(Continued on next page)

"Car of the Future"

The S.M.M.T. Competition Results

The first-prize winning design is on the right, and the second-prize winner on the left

THE "Car of the Future" Competition was judged on December 18th, 1946, at the headquarters of the Society of Motor Manufacturers and Traders. The panel of judges consisted of Mr. H. L. Kenward, President of the S.M.M.T., Mr. D. H. C. Wells, of the Motor Agents Association, Mr. E. Griffen, of the Motor Industry Research Association, Mr. F. G. Wollard, President of the Institution of Automobile Engineers, and the Rt. Hon. Lord Sempill, President of the Institute of the Motor Industry.

The first prize (£200) was won by Mr. L. A. Wilson, of Ickenham, Middlesex, with a rear-engined, four-door saloon which was very nicely finished. The second prize of £50 was won by Mr. W. J. Liddell, Jr., of Saintfield, County Down, Ireland, also a four-door saloon, but with the engine conventionally placed. Nearly all the models entered were, significantly, saloon cars, and the general tendency was towards the rear engine. In our opinion, there was not one design that really took the eye, although there was no dearth of good ideas. Then again, the practical side was rather overlooked. Several designs had curved, even bulbous, windscreens which would make a car so fitted definitely unpleasant to drive in bad visibility, and particularly on a dark wet night. The attendant refractions of oncoming traffic, and street lighting, even on a simple vee-windscreen, compares unfavourably with a flat screen in this respect; also, there was no indication of the type of screen-wiper which would be necessary for these multi-curved surfaces. Aerodynamics are all very well up to a point, but the designer must not lose sight of the fact that his proposed vehicle is roadborne, *not airborne*.

The 1st prize for the under-sixteens was a very commendable design of sound workmanship deservedly won by J. H. Peerless, of Brighton.

The drawings section was won by Mr. A. B. Winchcomb, of Upminster, Essex, with a prize of £50, the second was awarded to Mr. James Gibson, of Carstairs Junction, Scotland, with a prize of £25. Mrs. D. Clitheroe, of Menai Bridge, Anglesey, Wales, showed that a housewife is as capable of designing a car as a kitchen; her design was certainly well planned.

Altogether there were 14 national prize-winners and 25 divisional prize-winners for both models and drawings, with a special section for young people under sixteen with 10 prizes of £15.

The S.M.M.T. are to be congratulated in sponsoring these competitions, but we cannot help feeling that the response was a little disappointing.

Petrol Engine Topics

(Continued from previous page)

described in recent articles. The rotor shafts run in self-lubricating bushes, and are extended both ends, so that they may be coupled to engines running in either direction, or may be interposed in the main transmission shaft, if desired. I have not been able to test out one of these magnetos on an engine, but they spark quite efficiently at moderate speed.

New Blueprints

Readers are always clamouring for blueprints of designs which have appeared in THE MODEL ENGINEER, and so far as my own designs are concerned, I am doing my best to comply with these demands. The latest blueprints of my designs to become available are the "Atom Minor" Mark III, 6-c.c., and the "Zephyr" $2\frac{1}{2}$-c.c. two-stroke engines, the "Apex Minor" automatic carburettor, and the outlines of the 33-in. hydroplane hull "Golly." Other blueprints are in course of preparation, and will be announced as soon as they are ready.

A Simple Tube Cutter

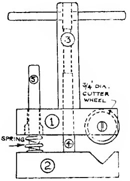
By H. G. Achard

THE sketches show a simple form of cutter for copper tubes, based on one which I used some years ago when on refrigerator service. Made to the dimensions given, I have used it up to $\frac{5}{8}$-in. dia. tubes, and, I think, with care one might just about manage $\frac{3}{4}$-in. o.d. It leaves a nice clean cut square to the wall of the tube and the very slight burr on the inside is easily removed with a small scraper or pen-knife.

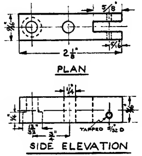
It is as well to purchase a wheel first to determine the length and breadth of the slot in piece 1. The wheel I used was $\frac{3}{4}$ in. dia., and cost 2s. 3d. It was a very thick one and I was obliged to grind away about $\frac{1}{16}$ in. of each side of the central boss ; otherwise, the slot would have had to be nearly $\frac{7}{16}$ in. wide, which would not have left much of the $\frac{9}{16}$ in. square—$\frac{5}{8}$ in. square can be used if available, of course.

The size of the wheel affects the position of the 5/32-in. tapped hole for the wheel "spindle" screw. Doubtless, readers more able than I could produce and temper their own wheels.

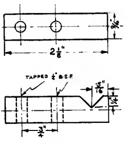
I don't think a detailed description of the process of manufacture is necessary, as the sketches are, I hope, self-explanatory. I am very satisfied with the cutter, however ; the square section enables a simple form of fence to be fitted, making the cutting of any amount of boiler flues, for example, dead to length, a simple job.



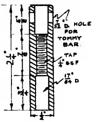
Assembly sketch of the simple tube cutter

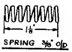


Part 1. $\frac{9}{16}$-in. square M.S. bar



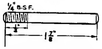
Part 2. $\frac{9}{16}$-in. square M.S. bar





Part 3. Nut, $\frac{1}{2}$-in. round M.S.

Part 4. Spindle $\frac{1}{4}$-in. silver steel



Part 5. Guide pin $\frac{1}{4}$-in. silver steel

Stephenson's Link Motion
and Some Important Considerations
By R. W. Dunn

THE object of this article is to put into intelligible language the functions of Stephenson's valve-gear, and to point out the causes, that readers may be experiencing with their locomotives, which are failing to give the desired results in tractive effort, etc., from the point of view of valve-settings. First, it will be necessary to refer briefly to valve functions, and events, and then deal with ideal settings for model locomotive valves. It can be safely stated that the great majority of model engineer novices do not understand properly the technical side of a slide-valve diagram, and how many tyros really follow what is happening to the valve events when "linking up"?

In full-size practice the valves are always set in the shops to the instructions issued by the drawing office, from the C.M.E.'s department. By using a diagram such as the Zeuner, a very clear idea of the action of the valve is obtained; literally, it is a picture of the valve events during the complete revolution of the crankpin. The Zeuner diagram is quite simple to follow, and when understood is much better to employ than the haphazard method so often given by the statements, "arrange the valve to cut off at 80 per cent. with so much lap, and lead, etc." The amateur cannot hope to get much information by carrying out these scanty instructions, and it is much better to quite understand what you are doing in this very important side of small locomotive construction.

In discussing any difference that exists in valve events of small locomotives, as compared with the full-size locomotive, it may be well to start with a reference to the following valve functions. *Positive Lead* is the amount the valve is open to steam at the dead centre beginning of the stroke, when in full gear. It is seldom used in locomotive practice. *Negative Lead* is the reverse to the above, and is more prevalent in full size locomotives because, on linking up, this lead favours a later cut off, with the effect that better tractive effort is obtained at the immediate increase of speed. *Exhaust Lap* or sometimes called *Inside Lap*, increases expansion by causing a later release, and there is consequently greater compression. It is not uncommon in slow speed or goods engines. *Negative Exhaust Lap*, often known as *Inside Lead*, is the reverse of exhaust lap, and it reduces expansion due to an earlier release, with subsequent later compression. Its main object is to avoid the possibility of back pressure at speed, and is commonly used in express passenger engines. *Steam Lap*, the most important feature, decides chiefly the point of cut off. It is the amount that the valve overlaps the steam edge of the valve port at each side of the valve when it is in its mid-position. In locomotive practice this is about equal to the port width.

Having explained these features, we can now define valve travel. If a valve has no lap, then obviously, for full-opening to exhaust, the valve travel would only need to be equal to twice the steam port width; but valves always have steam lap, and what is of much more importance, is to have maximum steam port opening in order to reduce pressure loss and wire-drawing at the entry of the steam. and also a perfectly free exhaust. This is a common failure in model locomotives; some have been seen in which the valve only opened a quarter of the steam port width, due to too short a valve travel, and resulting in pressure loss at the piston.

Now, valve travel = 2 (lap + valve opening to steam), and, in the above case, it would only be equal to :—2 (lap + a quarter width of the steam port), which is only about half what it should be. Therefore, the first thing to ascertain is that you have the correct amount of valve travel, and in models this should be 2 (lap + port width), thus ensuring that the steam velocity at maximum opening is kept as low as possible. Indeed, there is no reason why the valve should not actually overrun the port width, in which case a short period occurs before the valve again begins to cover the port, but the *time interval* of the actual opening is *the same* as for full port opening, because the valve is moving faster. Therefore, a small amount of extra work is performed in giving the valve this extra stroke, which only tends to make additional wear on the valve-gear. Finally, if, as mentioned above, we decide that the lap should be made equal to the width of the steam port, we get quite a simple deduction for the length of the valve travel, in terms of the cylinder bore, as follows: Travel = 2 (lap + port width); and, if lap = port, then travel = 2 (double port width) which is four times port width.

It must be noted here that the port width is measured *along* the centre line of the cylinder, and the length of the port is measured at right-angles to the centre line.

It is a well-accepted rule that the area of the steam ports should be equal to one-tenth the area of the cylinder, and model cylinders should have their ports made no less than this ratio, from which we can state,

$$\text{port area} = \frac{\text{cylinder bore}^2}{13}$$

The width of the steam port should be one-tenth of the cylinder bore, giving the length of the port 0.78 of the cylinder bore. From this, then the valve travel, in terms of the cylinder bore is :—

2 (double the port width) =

$$2\ \left(\text{twice } \frac{\text{cylinder bore}}{10}\right) = 0.4 \text{ of cylinder bore.}$$

The width of the exhaust port should be at least double the width of the steam port, and as a further argument for reducing the steam port velocity, we can, of course, increase the length of the ports to give a freer inlet and exhaust, against which there is nothing to be said; actually, this happens in the case of piston valves.

It is doubtful, however, for practical reasons of available space, whether the length of the ports in a "D" valve can be made longer than 0.78 of the cylinder bore. This matter leads us to enquire what is the working steam port velocity, which, of course, is dependent on piston speed.

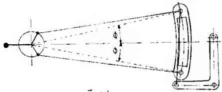


Fig. 1

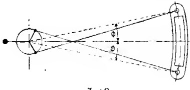


Fig. 2.

Piston speed is the average feet per minute that the piston is travelling within the cylinder. In a full-size locomotive, when running at between 60 and 70 m.p.h., the piston speed is around 1,500 ft. per min., and is calculated by multiplying the r.p.m. of the driving wheels by twice the piston stroke in feet. In models, the linear measurements vary inversely as the scale; so, in a 17/32-in. scale model locomotive the equivalent piston speed would be $\frac{1{,}500}{22.6} = 66$ ft. per min. Reckoning the port area at one-tenth the piston area, the velocity of the steam in the ports is therefore approximately ten times the piston speed, which would be 660 ft. per min., or 11 ft. per sec. This obviously gives a decided advantage to models as far as loss of pressure by friction in ports and passages is concerned; for, in a full-size locomotive, the steam entering the ports, when running at full speed and linked

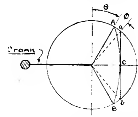


Fig. 3a

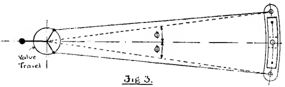


Fig. 3.

up, is somewhere about 120 to 150 ft. per sec., even allowing for the less volume of steam used by linking-up.

To make a comparison of this favourable friction loss in models, to what it is in the full-size engine, let us take an example. The established formula for steam pressure loss in pipe friction proves that pressure loss varies as velocity^2 and inversely as the diameter of the pipe. In a full-size engine having a 6-in. steam inlet pipe and a corresponding area of steam port, the model would have a ¼-in. bore pipe; then the ratio of friction loss in each case would be

$$\frac{120^2}{6} \text{ to } \frac{11^2}{\frac{1}{4}} \text{ or } 2{,}400 \text{ to } 484.$$

This shows that, in the case of the model, the loss by friction in steam ports and passages would be only one-fifth of that of the full-size locomotive, which is due mainly to the much reduced piston speed that prevails in model locomotives, yet running at the *same scale speed*. Then again, with the smaller working pressures that are usual in models, there is not much to be feared by pressure loss if the ports are proportioned as stated, with valve lap equal to port width, and travel equal to 0.4 of cylinder bore.

We will now deal with valve events on "linking-up," to follow which is not too easy for the tyro, but we will try to make it as clear as possible. Its object, obviously, is to reduce the power, and, therefore, the steam consumption, after the train load has been started. This is accomplished by causing the cut-off to be earlier, which occurs due to the travel of the valve being shortened on each side of its mid-position; thus, the valve may only just open the steam ports each end of the cylinder when near the mid-position. This earlier cut-off and reduced valve stroke is obtained in the following manner:—To visualise what is taking place on linking-up, one may assume that it is equivalent to driving the valve by substituting a number of smaller-throw eccentrics for each notch of the quadrant, each successively reducing the throw, but at the same time increasing the angle of advance on each other until mid-gear position is reached. This variation to the stroke of the valve-spindle during linking-up from full gear is due to what is known as an "equivalent eccentric"; that is, the hypothetical eccentric which results from the combined action of the foregear and back-gear eccentrics working together. In mid-gear the valve is equally influenced by both eccentrics, at which position the engine cannot run in either direction. Fig. 1 shows the arrangement of Stephenson's gear with "open" eccentric-rods; that is, with the crank on the outer dead centre.

This is the most common way of connecting them. If the rods were connected as shown in Fig. 2, that is, with the crank in the same position, then it is known as "crossed rods." The only reason for using crossed rods is that a decreasing lead of the valve is obtained during linking-up, whereas with open rods, the lead of the valve increases upon linking-up. It will be noted, however, that when the crank of any engine with open rods at the outer dead centre reaches the inner dead centre, the rods must obviously become crossed, but this is not the same proposition as shown in Fig. 2.

As most locomotives have the open rods arrangement, we shall deal with this accordingly. When an eccentric-rod is inclined to the axis of the valve spindle, the motion given to the valve is that which would be imparted by a slightly different eccentric, and this is known as the "virtual eccentric." It is due to the oblique drive, the valve spindle becoming "off-set" to the centre line when linking-up takes place. When either forward or backward eccentric is in full gear, the rods are practically in line with the valve die-block. Now this oblique drive has the effect that the eccentric appears to get gradually farther ahead of the actual angle of advance as the lever is notched-up from full-gear, and this increased angle is called the "virtual angle of advance." This angle is governed on any particular valve-gear by the angle made between the two forward and backward eccentric rods, and is known as ϕ^o, and found in the following way:—Referring to Fig. 3, we first draw out accurately to some fairly large scale the eccentric throw circles with their centres; also link-pin centres, with distance to crankshaft centre, all as shown. The angle ϕ^o is then found by drawing lines from the axis of the crankshaft to each pin centre at the link ends. The effect of this angle ϕ^o, on the valve at mid-stroke, is now shown in Fig. 3a. It is transferred, as shown, *added* to the angle of advance θ^o, for "open rods," where it will be noted that the greater the angle is, the longer will be the valve mid-stroke; for, by joining *a* and *b*, this line, where it cuts the centre line at C, gives the actual throw of the equivalent eccentric at mid-gear. If crossed rods were employed, the angle ϕ^o would be subtracted, instead of added to, θ^o, and this has the effect of giving a much shorter throw of the valve at mid-gear. If we now draw a line from the point C to A, and B, we get the approximate "characteristic" curve of the valve-gear, which means that any line drawn from the crankshaft centre to the boundary of this characteristic curve at any given point, will be the throw of the eccentric corresponding to that particular point of linking-up. Actually, this characteristic should take the form of a large-radius curve passing through the points A, C, and B.

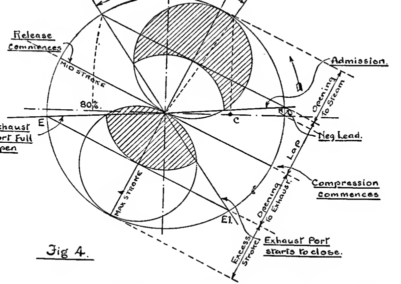


Fig 4.

It must be here pointed out that the virtual angle of advance affects very vitally the position at which the eccentrics are fixed to the crankshaft when locomotive links of the type shown in Fig. 1 are employed. In this case, the eccentrics must have a throw which will be greater than the required valve travel; but the point is how much greater? This is found by drawing the eccentric throw circle, from the same centre, and outside the valve circle; then by a continuation of the above characteristic curve, where it cuts the outer eccentric throw circle, will be the position of the correct eccentric centres and their true angle of advance.

Another method, perhaps more precise, is as described later; but before dealing with this, we had better have a few words on the "Zeuner" valve diagram. As mentioned previously, this

is really a picture of the valve events, and the first requirements to know for drawing it are: (1) lead of the valve, positive or negative; (2) required cut-off at full gear; (3) exhaust lap or inside lead, if any. The valve travel is known, being 0.4 of the cylinder bore, while the lap is about a quarter of the valve travel. We can now describe the valve circle, after putting in the centre-lines as shown in Fig. 4. This circle should be drawn to a scale at least ten times as large as the actual valve stroke. Set off next from the right-hand side of the circle, the cut-off as percentage of the stroke, and erect a perpendicular, produced with a compass set to the radius equal to the length of the connecting-rod; and where this cuts the circle is the relative position of the crank-pin at cut-off in its circular path. We then mark the lead point at the right-hand side of the circle, and if negative lead is to be given, we mark that above the centre-line; but if positive, below the centre line, showing that the valve would start to open before the piston is at the end of its stroke. In Fig. 4 it is shown as negative lead; the piston is then just commencing its stroke, before the valve starts to open to steam. The lead is measured by the small radius R, and then a line is drawn from the crank centre cutting the valve circle where shown touching the rad. R. With this point, and the one where the cut-off line cuts the circle, allows us to obtain the angle of advance θ°, for bisecting the two lines somewhere on the valve circumference, gives you the required angle, being measured between the radius of bisection and the vertical centre line. On this angle of advance line, we draw in two valve displacement circles as shown, and the lap of the valve is drawn in with radius equal to the port width where it should meet the point of intersection with the cut-off line and the valve circle, and the radius will also be found to meet at the intersection of the lead radial line as shown.

Turning now to the lower half of the diagram, or the exhaust on the return stroke for the same port, by drawing in a line across the diameter of the valve circle, and at 90° to the angle of advance, we get the valve commencing to open to exhaust immediately it has reached mid-stroke, as there is no exhaust lap; then with a radius equal to the width of the steam port, we draw this on the lower valve circle, and the part shown shaded in this circle is the period of opening to exhaust. Now if a cardboard strip, to represent the crank is pivoted at the centre axis, to swing around the valve travel circle, the position of the valve can be seen at the point where the edge of the cardboard strip touches the circumference of the valve displacement circle, and, therefore, the exact location of the valve, for any part of the piston stroke. Starting at the front dead centre, using our strip, it is seen that admission begins at the point of opening to steam shown where it begins to meet the shaded area, the area of opening then gets bigger until the valve is at maximum stroke, then it starts to close the port until fully closed at the cut-off point; we then get expansion until the valve gets to its mid-stroke, and the exhaust port starts to open, which is the release point. After this, the port becomes fully open at the point E, and remains fully open until the point E1 is reached, when the valve then begins to close the port; but it does not become fully closed until the next mid-stroke position of the valve, and then compression begins up to the time of re-admission. All these events can be clearly demonstrated by the use of the cardboard strip, presenting an exact picture of what is happening, as formerly stated.

The compression period helps to cushion the returning mass of the reciprocating parts, and also assists in reducing clearance volume loss, thereby creating a pressure in the steam left when the exhaust closes, somewhere near the incoming steam pressure at admission. This, then, completes the valve events by the Zeuner diagram for the front end of the cylinder, and the opposite port would be the same for similar lap and lead, and, as explained, should not be difficult to follow.

(To be continued)

12 mm. SPARKING PLUGS

ALTHOUGH the smaller sizes of miniature plugs are by far the most popular among users of model petrol engines at the present day, there is still a substantial demand for larger and more robust plugs for use on high-performance engines of 15 c.c. and upwards. For many years prior to the war, the 12-mm. plug was almost universally employed in model speedboat engines, and one of the most satisfactory plugs in this size was that originally produced by Bosch for use in light aircraft engines. Two grades of Bosch 12-mm. plugs were available in this country, the standard type, for engines of moderate performance, and a harder type being distinguished by the double green band on the insulator.

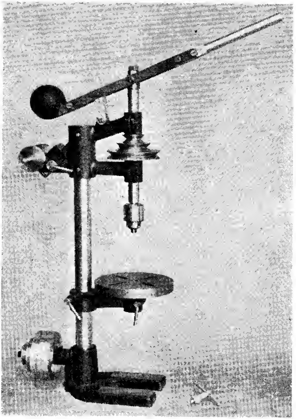
Readers who have used and appreciated these plugs, or new users of engines who find that the modern miniature plug does not satisfy their requirements, will be interested to learn that a limited stock of Bosch "Green Band" plugs have come on to the market and will be sold at less than the pre-war price, as long as they last. These plugs are brand new, and supplied either in cartons or other wrappings, as packed by the makers. It may be of interest to know that this type of plug was very extensively employed by the Germans during the war for small engines, such as portable generators, so their reliability is beyond question. The standard reach of these plugs is $\frac{3}{8}$ in. and the pitch of the thread, 1.25 mm. is a very close approximation to 20 t.p.i.

All enquiries should be addressed to Mr. Ian Bradley, "Ravenswood," East Horsley, Surrey.

Small Drilling Machines

We have received from the Morlena Machine Tool Co., 4, Bute Avenue, Derby Road, Lenton Sands, Nottingham, particulars of a small drilling machine which they are producing, and which is of a type well suited to the requirements of model engineers. The general design of the machine, as will be seen from the photograph, is very similar to that of the well-known "M.E." sensitive drilling machine, which has been well tried, and found to be highly efficient for work within its scope.

The specification of the machine is as follows: Capacity, 0 to ¼-in. drills; clearance in front of pillar, 3½ in.; table diameter, 4½ in.; standard length of column, 14½ in.; maximum spindle traverse, 2 in. Three speeds are obtained with constant belt tension and alignment, but as it is possible to drive either step of the headstock pulley from any step of the countershaft pulley, nine speeds are obtainable in emergency.



The drill spindle is made from high-tensile steel, ground to precision limits, and takes standard geared drill chucks. Main spindle bearings are split for adjustment, and a ball thrust race is fitted to the spindle. The lever pivot pins are hardened, and Allen type screws are used for the permanent securing of the structural parts. Alignment of the spindle and table socket is guaranteed to close limits. The machine is finished in light grey high gloss enamel, and a Jacobs type chuck is fitted as standard.

For the Bookshelf

Elementary Woodwork. By F. H. Harmsworth. London: Percival Marshall and Co. Ltd.. Price 5s. od. net.

Woodwork is a craft which attracts the attention of old and young alike, and there have been many "introductions" to the subject written with a view to stimulating first the urge and then the aptitude to produce a variety of useful objects made of wood. Yet here is a book which is not quite like any other written about this subject; for the text, while obviously designed to teach the reader how to do things, is anything but dull, and is essentially readable and interesting.

The illustrations consist of 62 line drawings and 24 excellent half-tone reproductions of photographs, the purposes of which are obvious; they are at once helpful and stimulating. We have no hesitation in stating that this book achieves its object in unmistakable manner, and we believe it will command a ready sale among societies and schools everywhere, as well as among professional and amateur craftsmen and novices.

A Short History of the Railway Carriage. By R. W. Kidner. The Oakwood Press, 30, White Horse Hill, Chislehurst, Kent. Price 3s. 6d. net.

This little book is Part 5 of the series "A Short History of Mechanical Traction and Transport," and is uniform, in size and format, with previous parts. It traces the history of railway passenger rolling-stock from 1825 to the present day, and is illustrated by twenty interesting photographs as well as numerous pen-and-ink sketches by the author. The text is admittedly brief; but it is interesting and authentic.

Letters

"Neglected Locomotives"

DEAR SIR,—May I comment on the letter written by A. E. Newbury in a recent issue

He states " . . . our old and faithful friend, the steam locomotive, has to contend with, for there is the enemy within the gate." There has been a tendency now and for some years past to make eng nes " common user." Engines are pooled and " control " allocates them to the train duty they should perform. Those whose duty it is to care for the eng.nes seem to have lost all pride in their charges; can one wonder when they are constantly told by an unseen telephone voice that they know best? Constantly we hear the phrase " Controls engines " ; let control look after them. The result is that everyone gets just a little disheartened defend'ng the cause of the engines. Coupled with prompt demands for trains to be worked, engines are kept out of locomotive sheds as long as possible. This has been made worse by some six years of destruction and is similar to what took place after the 1914-18 war. As little as possible has been done to the engines, and the outside condition has been reflected in the cab. Coalway shovelling plates not renewed, inside of cabs not painted, tool boxes and food boxes not repaired or painted. Many joints in the cabs not steamtight, and everything in a filthy condition.

I was surprised a short while ago to see a driver and fireman cleaning the outside of the boiler, while the smokebox door had all the fittings bright. The cab, too, had all the brass work scoured up and everything was clean and tidy. The enginemen told me that their shedmaster believed in an engine being rostered to two sets of men who work the same engine each day. As trains have to be worked, it does seem reasonable to group them (so far as passenger workings are concerned) so that regular engines can be booked to the men.

It is not possible to make an engine common user the same as a wagon. Even " Control " cannot make their own lead pencils common to all. There should be more understanding between control and the running shed staff. Let them come into the sheds and see the eng'nes being cared for by the different grades of shed staff and regard the engines in the proper light and not as mere numbers.

It is good news to hear that all the engines of the L.N.E.R. are to have a proper repair as they pass through the works and to be turned out equal to new. That all engines are to be either blue or green and more attractive to all, is a step in the right direction. The railway companies have reason to value the goodwill of the travelling public and the interest taken in the locomotive rolling stock.

In regard to the complaint about engine numbers being so dirty, I am quite aware of the fact, and chalk numbers are a great help in the dimly-lit engine sheds and locomotive sidings. As for the many instructions chalked on the cab-sides, they are to be observed, the familiar " W.O." showing that the firedropper on the pits has to throw the fire out as the boiler is due to be washed out.

The common " S.A.P. " does not mean the value of the engine, but just " stable and prepare."

It is to be hoped that some other means will be found instead of the unsightly chalk marks as conditions improve.

Yours faithfully,

" PROGRESS."

Clubs

Blackpool Society of Model Engineers

Through the generosity of the Blackpool Education Committee we have obtained a room at the Blackpool Technical College. Our first meeting was held on January 6th, at 8 p.m., and future meetings will be held every fortnight until further notice.

Members recently visited the Blackpool Electricity Works, and spent two hours of great interest there. The society is shortly to visit the L.M.S. Locomotive Works, at Horwich, and the Crown Paper Mills on the same day.

Membership is growing each month, but we invite new members, who are asked to contact the Hon. Secretary: CHARLES BAND, 220, Caunce Street, Blackpool.

The Newport (Mon.) and District Society of Model Engineers

Details of future meetings are :—

January 23rd, talk by Mr. F. A. Sully, " Constructing a 3.11-c.c. 2-stroke Petrol Engine."

February 13th, special talkie show of items of engineering interest.

Hon. Secretary: S. MARSHALL HALL, 102, Fields Park Road, Newport, Mon.

The Bolton and District Society of Model Engineers

The annual general meeting was held on January 14th, in the Co-operative Rooms, Bridge Street, Bolton. This change of meeting place has become necessary because of increasing attendance at the meetings, and members who have attended the last few meetings will know the difficulty they had in getting a seat.

Hon. Secretary: A. H. BOOTHROYD, 113, Hilton Lane, Little Hulton, Nr. Bolton.

Swansea Society Model Engineers

The society has recently acquired new premises which will give ample accommodation for the $2\frac{1}{2}$ in. and $3\frac{1}{2}$-in. gauge passenger-carrying track now nearing completion, by the enthusiastic "live steam " section. The 7-mm. scale modellers, with a room 25 ft. 0 in. by 16 ft. 0 in. at their disposal, will now proceed with a Gauge " O " layout, all the material for which is already to hand.

Meetings are held on Wednesdays and Saturdays, at 7 p.m. New members will be welcomed.

Hon. Secretary: H. L. FRANKLING, 497, Gower Road, Killay, Swansea.